



The 26th International Conference on
Automated Planning and Scheduling

London, June 2016

Welcome

The ICAPS 2016 Conference would like to acknowledge the generous support of:

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General Information

On-Site Information

The conference is being held at the Strand Campus of King's College London, telephone +44 (0)20 7836 5454, postcode WC2R 2LS.

There are two main entrances:

- Into the King's Building, from the courtyard. This is accessible either by walking down the path adjacent to the car barrier from the Strand; or via the terrace overlooking the Thames. The main ICAPS conference presence will be at this entrance.
- Directly from the Strand – walk through the revolving doors, past the Strand reception and carry on indoors down the long corridor into the King's building.

(For those attending the Doctoral Consortium on Sunday, please enter via the security office adjacent to the car barrier.)

Free WiFi is provided via **The Cloud** or **eduroam** wireless networks. It is strongly recommended that those who have eduroam access use it, to share bandwidth effectively between attendees.

Mains power is at 230V, with British three-prong plugs. Note that plug sockets often have built-in power switches: if you plug your laptop or phone in to a switched socket to charge, check it is receiving power.

The local currency is the British pound (Sterling). There is an ATM by the Strand Reception, though credit and debit cards are accepted in virtually all shops and restaurants.

For non-emergency matters, speak to one of the local arrangements team, or ring the strand reception on the number above. In case of emergency on-site, call +44 (0)20 7836 2222. Off-site, for emergency services, ring 999.

Local Transport Links

Public transport in London uses contactless pre-paid Oyster Cards: **buses do not take cash**, and cash fares on the tube (the London Underground) are around double those of Oyster cards. Oyster cards can be purchased for a refundable £5 deposit; ensure you touch-in and touch-out at the start and end of your journeys, to pay the correct fare.

The nearest tube station is **Temple**: leaving via the Strand reception, walk out and right; turn right down Surrey Street; then left at the bottom – the station is then 100m on the right. The nearest London bus stops are those on the Strand for **Somerset House**. These are either outside the college or slightly further west towards Somerset House itself.

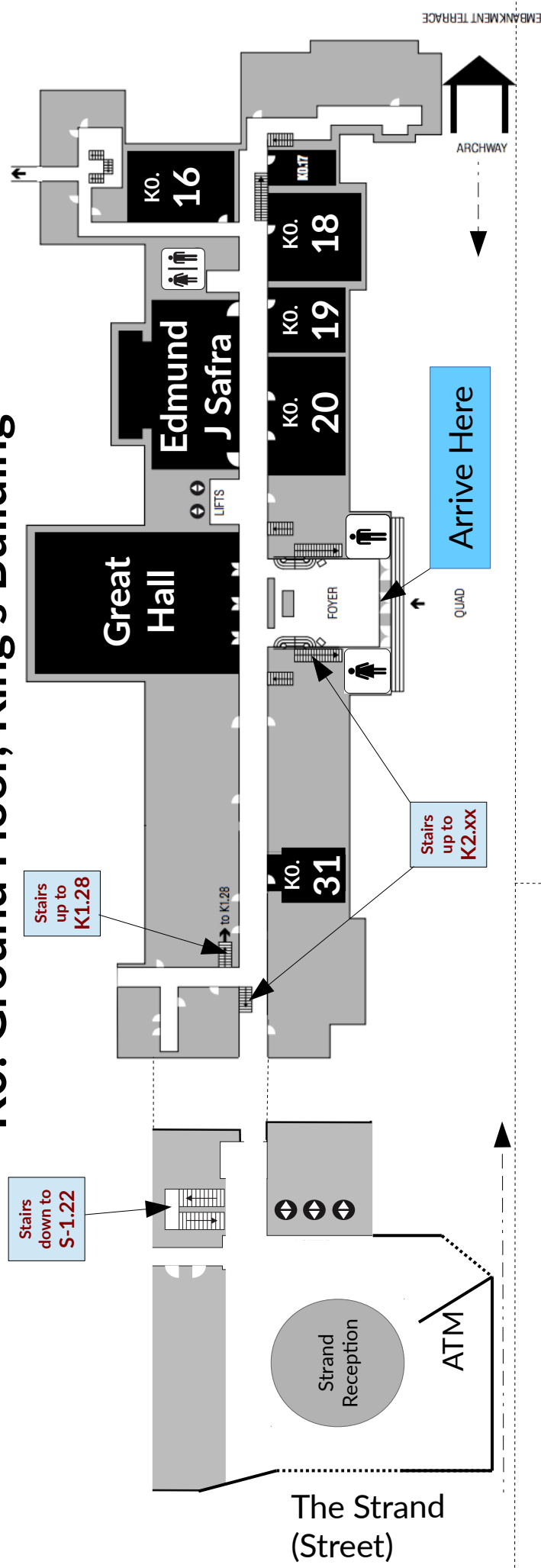
To hail a taxi on the street, look for a black cab with the 'TAXI' light on the roof illuminated – this indicates it is available for hire. Uber operates in London, and are usually available on the Strand with a couple of minutes' notice.

Floor Plans; Maps for the Reception and Banquet

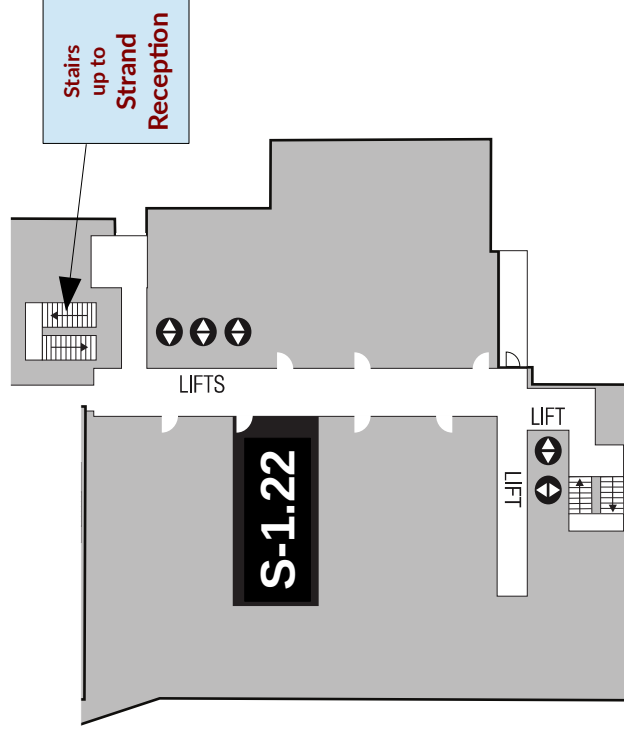
Floor plans follow this page. Each scheduled item notes which room it is in – most activities are on the ground floor of the King's Building (K0).

The opening reception and banquet are off-site at the London Eye, and on a boat departing Tower Pier, respectively. These are walking distance away; guided groups will leave the Strand to get there on time. The two pages of maps give an idea of the route involved.

K0: Ground Floor, King's Building

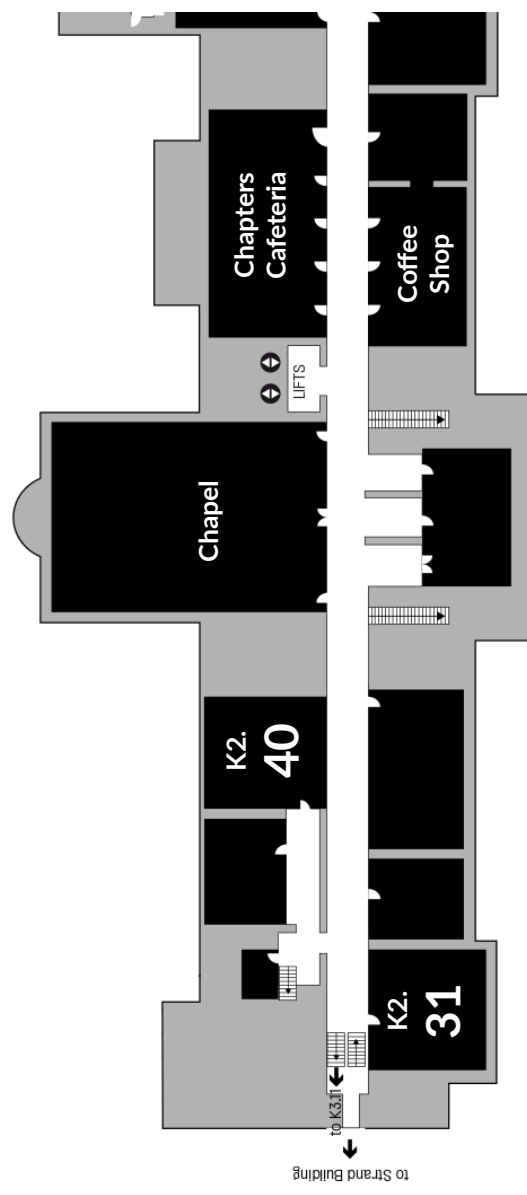


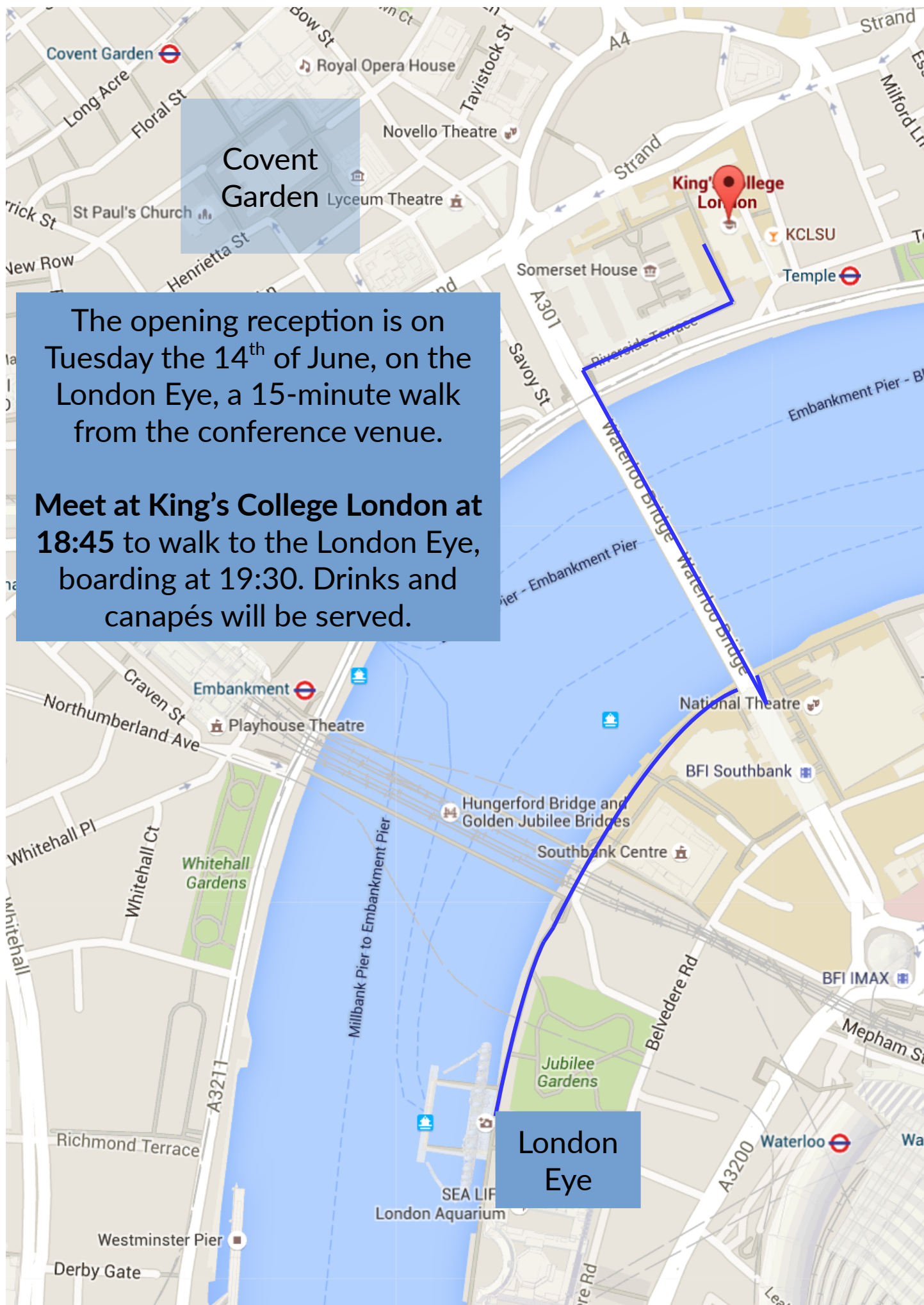
S-1: Strand Basement



K2: Floor 2, King's Building

(Sunday – DC; Monday – PlanRob; Friday – Coffee)





Covent
Garden

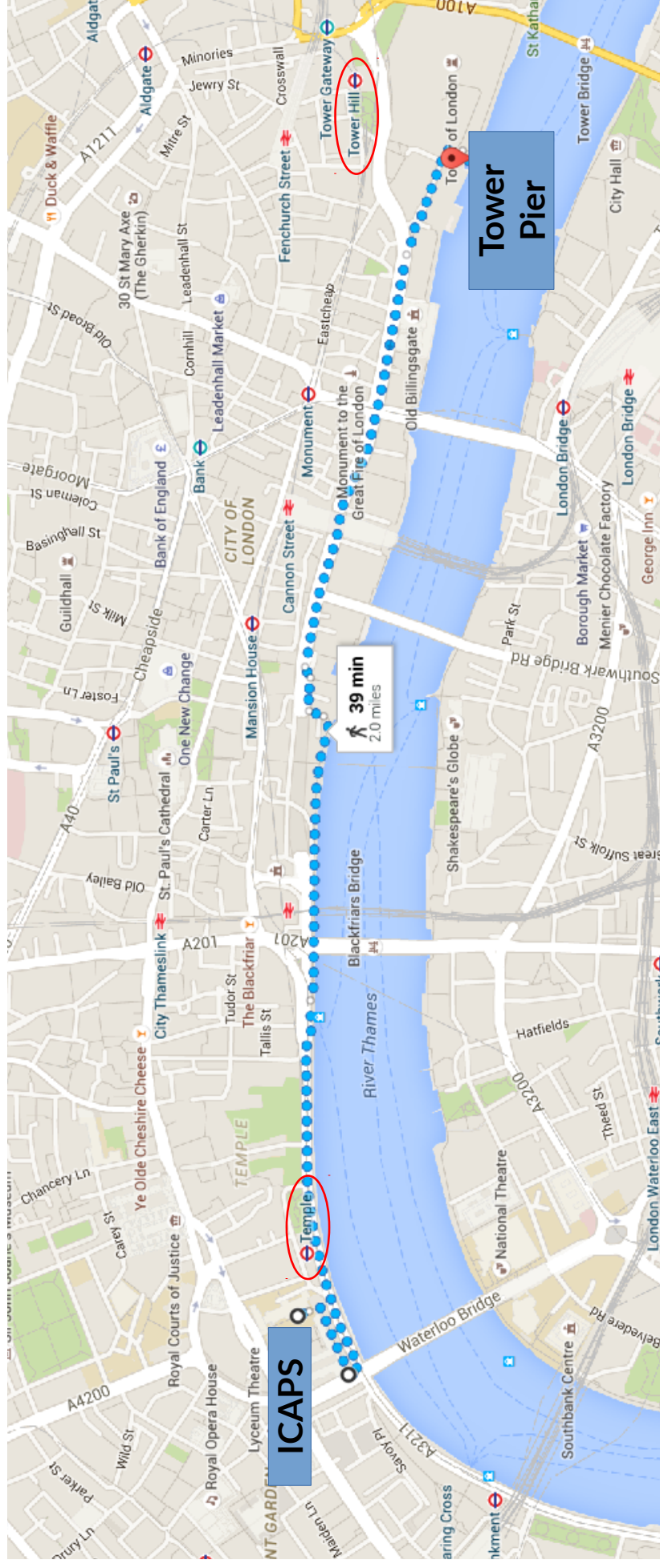
King's College
London

London
Eye

The opening reception is on Tuesday the 14th of June, on the London Eye, a 15-minute walk from the conference venue.

Meet at King's College London at 18:45 to walk to the London Eye, boarding at 19:30. Drinks and canapés will be served.

Thursday: Conference Banquet



The Conference Banquet is on the **Dutch Master** river boat. Embarkation is at 6:45pm at Tower Pier. As the boat is licensed premises, bring ID to prove your age: under 18s will be refused entry.

Do not be late, as we will set sail and not dock again until disembarkation at 11pm.

Walking groups will leave ICAPS after the Community Meeting.

Alternative route: from Temple tube station, take the District or Circle line east to Tower Hill.

Instructions for Speakers

Long papers are given 18 minutes + 4 for questions. Short papers and papers in the Journal Track are given 13 minutes + 2 for questions. To keep the conference on schedule, the session chairs will have to strictly enforce the time limit.

Please be in the room where you will be presenting some time before the session begins and introduce yourself to the session chair.

To minimise changeover times in what is a tight schedule, and to facilitate screen capture for video recording, a lectern computer running Windows 7 will be provided in each room. Please attend the break before the session containing your talk to transfer your slides onto this machine.

Conference talks are being video-recorded by default. You will be asked to sign a consent form to agree to this; if you do not want your talk to be recorded, then (politely) refuse to sign the form.

Instructions for Session Chairs

A member of the local arrangements team will be present to act as your assistant, to handle video-recording forms and pass around the microphone.

The schedule for parallel sessions is designed to be aligned: short talks alongside short talks, and so on. This is to allow attendees to move between sessions. If someone finishes early, pad the schedule to fit.

Instructions for Poster Presenters

The poster session will be in the Great Hall on Wednesday. There will be two one-hour poster sessions; you will be allocated to one. The poster boards will be erected by site staff during the Competition Results session, and posters are to be set up in the break immediately before the poster session itself.

Other Miscellaneous Information

There is a Tesco supermarket a short walk away that sells groceries, basic pharmacy supplies, and so on. Head west along the strand to the pedestrian crossing over Lancaster Place (the A301) – Tesco is on the other side of the road, next to Maplin.

There are plenty of good places to eat either right by King's (heading west or east on the Strand), or towards Covent Garden (north west). The following pages note some of our recommendations, but are by no means exhaustive.

Lunch Recommendations

Pret a Manger

Take-out sandwiches (£3), soup (£3), salads (£4). 135 Strand, WC2R 1HH

<http://www.pret.co.uk/en-gb/>

Caffe Nero

Italian style coffee shop, serving panini (£4), coffee (£2) and cake (£2).

2 Lancaster Place, WC2E 7EA

<http://www.caffenero.co.uk/>

The Crown Cafe-Bar

A small Italian cafe serving pastas, salads, and sub-sandwiches. A portion of pasta is £5-£6

136 Strand, WC2R 1HH

Chilango Mexican Restaurant

A Mexican fast food chain serving delicious burritos, salads and nachos. A burrito and a drink starts from £6.
142 Fleet Street, EC4A 2BP
<http://chilango.co.uk/restaurants/fleet-street/>

Pilpel

Middle Eastern fast food chain serving falafel, houmous and salads. A falafel pita is £5.40.
146 Fleet Street, 1a Wine Office Court, London, EC4M 3BY
<http://www.pilpel.co.uk/>

Fernandez and Wells at Somerset House

Serving Spanish style sub-sandwiches and delicious coffees in historic Somerset House (next to the King's Building).
Strand, WC2R 1LA
<http://www.fernandezandwells.com/shop/somerset-house/>

Thai Square

Contemporary Thai chain restaurant with bronze Buddhist sculptures and traditional carvings.
148 The Strand, London, WC2R 1JA
<http://thaisq.com>

Homeslice Pizza

A wood fired pizza restaurant in Covent Garden. A 20 inch pizza for two is £20
13 Neal's Yard, WC2H 9DP
<http://www.homeslicepizza.co.uk/>

On the Bab Korean Restaurant

A Korean street food restaurant. A main dish costs around £8.
36 Wellington Street, WC2E 7BD
<http://onthebab.co.uk/>

Honest Burgers

A burger and chips start from £8
33 Southampton Street, WC2E 7HE
<http://www.honestburgers.co.uk/>

Le Pain Quotidien

Serves simple, elegant boulangerie fare – great bread, salads and desserts. Hot meals £10.
48-49 The Market, Covent Garden, WC2 8RF
<http://www.lepainquotidien.co.uk/store-menu/covent-garden-menus/>

Meat Market

A casual, American diner style burger joint in Covent Garden. A burger & chips start from £11
Jubilee Market Hall, Tavistock Street, WC2E 8BE
<http://themeatmarket.co.uk/>

Five Guys

An American burger joint in Charing Cross. A burger & chips start from £8
9/11 Villiers Street, Charing Cross, WC2N 6NA
<https://www.fiveguys.co.uk/>

Sagar

A south Indian vegetarian restaurant. Ask about the lunch special for an excellent value meal.

31 Catherine Street, Covent Garden, London, WC2B 5JS

<http://m.sagarveg.co.uk/>

Tom's Kitchen

Situated on the ground floor of the iconic Somerset House building, Tom's Kitchen serves comfort food favourites in a relaxed and informal environment from lunch to dinner and brunch on weekends. Main course starts from £14.

Somerset House, Strand, London WC2R 1LA

<http://www.tomskitchen.co.uk>

Viandas de Salamanca

Iberian ham sandwiches. Take out only.

99 Strand, London, WC2R 0EU

<http://viandasdesalamanca.es/home/web/blog/2014/viandas-de-salamanca-por-el-mundo-londres/>

Dinner Recommendations

Franco Manca Pizza

A sourdough pizza restaurant. Regular size pizzas start from £6

39 Maiden Lane, WC2E 7LJ

<http://www.francomanca.co.uk/>

La Tasca

A tapas style Spanish restaurant. £5 for a small dish.

23-24 Maiden Lane, WC2E 7NA

<http://latasca.com/>

Rossopomodoro

A neapolitan style restaurant chain. Regular size pizzas start from £12.

50-52 Monmouth Street, WC2 H9EP

<http://www.rossopomodoro.co.uk/>

Nando's

Afro-Portuguese chain restaurant serving flame-grilled chicken in spicy chilli sauce.

66-68 Chandos Pl, Covent Garden, WC2N 4HG

<https://www.nandos.co.uk/>

Cafe Rouge

Classic French dishes with a contemporary twist.

34 Wellington St, Covent Garden, WC2E 7BD

<http://www.caferouge.com>

Palm Court Brasserie

Parisian-style brasserie in a 1920s art nouveau environment.

39 King Street, Covent Garden, WC2E 8JS

<http://www.palmcourtbrasserie.co.uk/food-menus.php>

Chiquito

Colourful chain restaurant dishing up a menu of Tex-Mex favourites, beer and cocktails.
20-21 Leicester Square, London WC2H 7LE
<https://chiquito.co.uk>

Smith and Wollensky

Chophouse chain outpost serving prime steaks & seafood in a clubby, power-dining setting. A main course starts from £16.
The Adelphi, 1-11 John Adam St, London WC2N 6HT
<http://www.smithandwollensky.co.uk/>

Santoré

A comfortably rustic Italian restaurant. A pizza starts from £8.25.
Farringdon, 59-61 Exmouth Market, London EC1R 4QL
<http://www.santoreresrestaurant.london>

Manchurian Legends

Specialises in Dongbei (or Northeast) Chinese cuisine. An excellent choice in Chinatown, particularly if you like your food spicy.
16 Lisle Street, Chinatown, London WC2H 7BE
<http://www.manchurianlegends.com/>

Hawksmoor

Widely regarded as the best steak in London. Has a good value express menu before 6:30, and does a brilliant Sunday roast.
11 Langley Street, WC2H 9JG
<http://thehawksmoor.com/locations/seven-dials/>

Flat Iron Steak

Another well regarded steak restaurant, not as expensive as Hawksmoor. They don't take bookings so be prepared to queue.
17 Beak St, Soho, W1F 9RW
9 Denmark St, Soho, WC2H 8LS
17/18 Henrietta St, Covent Garden, WC2E 8QH
<http://flatironsteak.co.uk/>

Som Saa

Specialises in regional Thai dishes. Can only book for parties of 4-6, otherwise be prepared to wait for a table, this place is popular.
43A Commercial Street, Spitalfields, E1 6BD
<http://www.somsaa.com/>

Clockjack

Rotisserie roasted, free-range chicken with chips, in a wood and slate space with shared tables.
14 Denman Street, London, W1D 7HJ
<http://www.clockjack.co.uk/>

Joe's Southern Table and Bar

Deep South cooking. Fried chicken, mac & cheese, wings, cocktails, corn bread....
34 King Street, Covent Garden, WC2E 8JD
<http://joessouthern.co.uk/covent-garden/index>

Outstanding Paper and Reviewer Awards

Main Track

Outstanding Paper Heuristic Search in Dual Space for Constrained Stochastic Shortest Path Problems
Felipe Trevizan, Sylvie Thiebaux, Pedro Santana, Brian Williams

Outstanding Student Paper Practical Undoability Checking via Contingent Planning
Jeanette Daum, Álvaro Torralba, Joerg Hoffmann, Patrik Haslum, Ingo Weber

Outstanding Reviewer Malte Helmert

Robotics Track

Outstanding Paper Multi-Agent Path Finding with Kinematic Constraints
Wolfgang Hoenig, T. K. Satish Kumar, Liron Cohen, Hang Ma, Hong Xu, Nora Ayanian and Sven Koenig

Outstanding Reviewers Laura Hiatt and Kanna Rajan

Novel Applications Track

Outstanding Paper Optimal Scheduling of a Constellation of Earth-Imaging Satellites, for Maximal Data Throughput and Efficient Human Management
Sean Augenstein, Alejandra Estanislao, Emmanuel Guere and Sean Blaes

Outstanding Reviewers Shirin Sohrabi and Roman Bartak

Schedule Overview

Sunday (June 12, 2016)

Doctoral Consortium See page 19 for the detailed schedule.

ICKEPS 2016 The Fifth International Competition on Knowledge Engineering for Planning and Scheduling. Details on page 21.

Monday (June 13, 2016)

Time	Room				
	S-1.22	K0.16	K0.18	K0.20	K2.40
08:00–	Registration				
09:00–10:30	T1	HSDIP	SafePlan	-	PlanRob
10:30–11:00	Coffee Break				
11:00–12:30	T2	HSDIP	SafePlan	-	PlanRob
12:30–14:00	Lunch				
14:00–15:30	T3	HSDIP	SafePlan	ICKEPS	PlanRob
15:30–16:00	Coffee Break				
16:00–17:30	T3	HSDIP	SafePlan	-	PlanRob

NB Consult workshop schedules for precise timing of sessions – some may start earlier or finish later.

Workshops

HSDIP Heuristics and Search for Domain-independent Planning (all day). Detailed schedule on page 24.

SafePlan Planning, Scheduling and Dependability in Safe Human-Robot Interactions (all day). Detailed schedule on page 25.

PlanRob Planning and Robotics (all day). Detailed schedule on page 27.

Tutorials Details on page 22

T1) Working with the Planning.Domains API Christian Muise. Quarter Day

T2) Planning with State-Dependent Action Costs Robert Mattmüller and Florian Geißer. Quarter Day

T3) Multi-Objective Planning under Uncertainty Shimon Whiteson and Diederik M. Roijers. Two Quarter Day Parts

ICKEPS demos Details on page 21

Tuesday (June 14, 2016)

Time	Room			
	S-1.22	K0.16	K0.18	K0.20
08:30–	Registration			
09:00–10:30	T4	DMAP	SPARK	PlanRob
10:30–11:00	Coffee Break			
11:00–12:30	T5	DMAP	SPARK	PlanRob
12:30–14:00	Lunch			
14:00–15:30	COPLAS	DMAP	SPARK	T6
15:30–16:00	Coffee Break			
16:00–17:30	COPLAS	DMAP	SPARK	T6
18:45–	Meet to depart for Opening Reception			

NB Consult workshop schedules for precise timing of sessions – some may start earlier or finish later.

Workshops

PlanRob Planning and Robotics (morning). Detailed schedule on page 27.

SPARK Scheduling and Planning Applications woRKshop (all day). Detailed schedule on page 29.

DMAP Distributed and Multi-Agent Planning (all day). Detailed schedule on page 31.

COPLAS Constraint Satisfaction techniques for planning and Scheduling (afternoon). Detailed schedule on page 33.

Tutorials

Details on page 23

T4) Decision Diagrams for Discrete Optimization John Hooker. Quarter Day

T5) Decision Diagrams for Sequencing and Scheduling Willem-Jan van Hoeve. Quarter Day

T6) Planning Competition for Logistics Robots in Simulation Tim Niemueller, Erez Karpas, Tiago Vaquero, and Eric Timmons. Half Day

Invited Talk

Mastering the Game of Go with Deep Neural Networks and Tree Search

David Silver

Google Deep Mind

Wednesday 15th June 08:30 – 09:30

Room: Edmund J Safra

Abstract

The game of Go has long been viewed as the most challenging of classic games for artificial intelligence owing to its enormous search space and the difficulty of evaluating board positions and moves. Here we introduce a new approach to computer Go that uses 'value networks' to evaluate board positions and 'policy networks' to select moves. These deep neural networks are trained by a novel combination of supervised learning from human expert games, and reinforcement learning from games of self-play. Using this search algorithm, our program AlphaGo achieved a 99.8% winning rate against other Go programs, and defeated the human European Go champion by 5 games to 0. This is the first time that a computer program has defeated a human professional player in the full-sized game of Go, a feat previously thought to be at least a decade away.

Bio

David's research focuses on reinforcement learning, planning and control. David leads a research group on reinforcement learning at Google DeepMind. His recent work has focused on combining reinforcement learning with deep learning, including a program that learns to play Atari games directly from pixels and AlphaGo that recently become the first artificial intelligence program to beat a top-ranked Go professional. David holds a Royal Society University Research Fellowship and is a lecturer at University College London. His PhD (supervised by Rich Sutton at the University of Alberta) was on reinforcement learning in Computer Go, which co-introduced the algorithms used in the first master level Go programs. In his previous life, he was CTO at Elixir Studios and Lead Programmer on Republic: the Revolution.



Invited Talk

Making Plans for Human Users

Susanne Biundo

Ulm University

Thursday 16th June 08:30 – 09:30

Room: Edmund J Safra

Abstract

User-centered planning is a strand of the field that investigates a variety of AI planning functionalities that go beyond the mere generation of plans. It aims at the realization of comprehensive plan-based user support as the core functionality of advanced assistance systems. In this talk, we introduce a hybrid planning formalism designed for user-centered planning. It combines features of hierarchical task networks and partial-order causal-link planning in a well-defined manner, thereby reflecting and explicitly representing the causal and hierarchical reasoning planning is about. We discuss the theoretical properties of this formalism as well as implementation aspects and show how plan generation, plan explanation, plan repair, plan recognition, and mixed-initiative planning are realized within this integrative framework. Finally, we present two assistance systems where the combination of these planning capabilities implements the support of users in complex assembly tasks and in the compilation of individual fitness-training programs, respectively.

Bio

Susanne Biundo received her Ph.D. (Dr. rer. nat.) from the University of Karlsruhe in 1989. She held a Senior Research Position at the German Research Center for Artificial Intelligence (DFKI) from 1989 to 1998. Since 1998, she is a Professor of Computer Science at Ulm University. She is the director of the Institute of Artificial Intelligence and the Chair of the Transregional Collaborative Research Centre "Companion-Technology for Cognitive Technical Systems". Susanne Biundo was a founding member of the Executive Council of ICAPS, the International Conference on Automated Planning and Scheduling, where she served from 2002 to 2008. Among further professional activities, she acted as the Conference- and Program Co-chair of ICAPS 2005 and as the Program Chair of the "5th European Conference on Planning" (ECP-99). Susanne Biundo was the initiator and coordinator of PLANET, the "European Network of Excellence in AI Planning", which she led from 1998 to 2003. In 2004, she was elected ECCAI Fellow.



Invited Talk

Real-time Planning for Real-Time Traffic Control

Stephen Smith

Carnegie Mellon University

Friday 17th June 08:30 – 09:30

Room: Great Hall

Abstract

Real-time traffic signal control presents a challenging multi-agent planning problem, particularly in urban environments where (unlike simpler arterial settings) there are competing dominant traffic flows that shift through the day. Urban environments also require attention to multi-modal traffic flows (vehicles, pedestrians, bicyclists, buses) that move at different speeds and with different priorities. For the past several years, my research group has been evolving an adaptive traffic signal control technology to address these challenges, referred to as Surtrac (Scalable Urban TRAffic Control). Surtrac combines principles from automated planning and scheduling, multi-agent systems, and traffic theory. It is designed to operate in a totally decentralized manner, where each individual intersection repeatedly solves a special type of single machine scheduling problem to generate signal timing plans in real-time that optimize movement of the sensed approaching traffic. These plans are then communicated to downstream neighbors to achieve coordinate behavior (e.g. green progressions). Surtrac has produced significant improvements in traffic flow efficiency and air quality in the field, and currently controls a network of 50 intersections in the East End area of Pittsburgh PA. Current research with Surtrac focuses on integration of adaptive signal control with emerging connected vehicle technology, and on the development and use of performance self-monitoring capabilities. Other, more basic research is investigating the potential of economically motivated approaches to adaptive signal control, which give agency and decision-making influence to individual drivers. This talk will provide an overview of this overall research effort.

Bio

Stephen Smith is a Research Professor in the Robotics Institute at Carnegie Mellon University, where he heads the Intelligent Coordination and Logistics Laboratory. Smith's research focuses broadly on the theory and practice of next-generation technologies for planning, scheduling, and coordination. He pioneered the development and use of constraint-based search and optimization models for solving planning and scheduling problems, and has successfully fielded AI-based planning and scheduling systems in several complex application domains. Smith has published over 250 papers on these and related subjects. He was a founding member of the ICAPS council and program co-chair of ICAPS 2006. He is currently a member of the AAAI Executive Council, is Associate Editor of the Journal of Scheduling, and serves on the editorial boards of Constraints and ACM Transactions on Intelligent Systems and Technology. He was elected AAAI Fellow in 2007.



ICAPS Planning Competition for Logistics Robots

Competition kick-off events:

Tuesday afternoon: Tutorial T6, room K0.20

Wednesday: System demo

With robots becoming ever more capable, both in terms of perception and manipulation, and with the desire to solve tasks of increasing complexity and higher relevance, the design and composition of robot behavior is becoming more complex and tedious. To enable wide adoption of robots, we need to automate this process, thus improving longevity, extensibility, and robustness of integrated robot systems. We introduce here a competition and a decision architecture, with the goal of catalyzing progress towards this automation, within the ICAPS community.

Planning systems are a natural component for generating complex robot behavior. However, in deployed robotic applications, such systems are still the exception rather than the norm. Within the robotics research community, there is significant attention to developing, demonstrating, and evaluating capabilities for perception and manipulation; however, task planning has received less attention. The ICAPS community has the algorithmic talent to meet this need. To have impact, we also need to develop a grounded expertise with robotic scenarios, platforms, decision architectures, system integration and system evaluation.

To foster closer cooperation among the communities, we envision a new robotic planning competition, kicked off during ICAPS 2016, and to take place during ICAPS 2017. This competition will build upon the industry-inspired scenario of the RoboCup Logistics League (RCLL), which has a group of robots perform in-house logistics and job shop scheduling for a smart factory, and involves robots moving materials among processing machines.

A robotic system uses a task executive to coordinate between task planning, plan execution, sensing and manipulation in a continuous manner. Developing a task executive is a steep price of entry for working with robotic systems. To reduce this barrier, we will provide a planning executive (Enterprise) designed with APIs for plugging in PDDL activity planners and a variety of path planners.

As a preparation for this competition, we are holding a half-day tutorial at ICAPS 2016 to present the idea, introduce the competition's integrated framework, and to kickstart team interest. In addition, the competition simulation environment and Enterprise architecture will participate in the System Demonstration session.

Doctoral Consortium

Peter Gregory, Lee McCluskey and Fabio Mercorio

08:30–16:00 Room: K2.31

The Doctoral Consortium brings together junior and experienced researchers in planning, scheduling and related areas from across the globe, in particular those studying for a Doctoral degree. It provides a forum for networking with the ICAPS community (including mentoring, career guidance, and research skill advice) in an informal, social setting.

The Doctoral Consortium will be held as a full day workshop on June 12th, 2016. The program includes invited talks on research skill and career development, the opportunity for participants to give a short presentation, and a poster session during the main conference. This year there will also be an opportunity for participants to register and take part in the Knowledge Engineering Competition which will be run directly after the Doctoral Consortium finishes.

Heuristic Search and Applications

Room: K2.31 Time: 08:30-10:00

**Automated Planning and Scheduling E0 Constella-
tions' Operations using Ant Colony Optimization**

Evridiki Ntagiou

**Solver Paramter Tuning and Runtime Predictions of
Flexible Hybrid Mathematical models**

Michael Barry

**Constructing Heuristics for PDDL+ Planning Do-
mains**

Wiktor Piotrowski

Risk-Sensitive Planning with Dynamic Uncertainty

Liana Marinescu

Multi Agent Planning & Plan Execution

Room: K2.40 Time: 08:30-10:00

A Distributed Online Multi-Agent Planning System

Rafael Cardoso

**Integrating Planning and Recognition to Close the
Interaction Loop**

Rick Freedman

**Distributed Privacy-preserving Multi-agent Plan-
ning**

Andrea Bonisoli

Planning with Concurrent Execution

Bence Cserna

10:00

Break

Temporal Planning

Room: K2.31 Time: 10:30-12.30

**Mixed Discrete-Continuous Planning with Complex
Behaviors**

Enrique Fernandez Golzalez

Planning with Flexible Timelines in the Real World

Alessandro Umbrico

**POPCorn: Planning with Constrained Real Numer-
ics**

Emre Savas

**Planning with PDDL3.0 Preferences by Compilation
into STRIPS with Action Costs**

Francesco Percassi

**Planning Under Uncertainty with Temporally Ex-
tended Goals**

Alberto Camacho

**Temporal Inference In Forward Search Temporal
Planning**

Atif Talukdar

Planning and Scheduling

Room: K2.40 Time: 10:30-12.30

**Task Scheduling and Trajectory Generation of Mul-
tiple Intelligent Vehicles**

Jennifer David

Decoupled State Space Search

Daniel Gnad

**Hierarchical Task Model with Alternatives for
Predictive-reactive Scheduling**

Marek Vlk

Numeric Planning

Johannes Aldinger

**Exploiting Search Space Structure in Classical Plan-
ning: Analyses and Algorithms**

Matasaru Asai

SAT/SMT techniques for planning problems

Joan Espasa Arxer

Sunday (June 12, 2016)

12:30 Lunch

13:30 Invited Talk - Prof. Lee McCluskey: 'My Theory of the Research Paper: How to Write Your Own and be a Good Reviewer of Others' (Room K2.31)

Planning under Uncertainty and Applications
Room: K2.31 Time: 14:15-15:45

Robotic control through model-free reinforcement learning

Ludovic Hofer

Exploiting Symmetries in Sequential Decision Making under Uncertainty

Ankit Anand

Recommending and Planning Trip Itineraries for Individual Travellers and Groups of Tourists

Kwan Hui LIM

Constructing Plan Trees for Simulated Penetration Testing

Dorin Shmaryahu

Optimization Approaches to Multi-robot Planning and Scheduling

Kyle Booth

Knowledge Engineering and Applications
Room: K2.40 Time: 14:15-15:45

Learning Static Constraints for Domain Modeling from Training Plans

Rabia Jilani

Using GORE method for Requirement Engineering of Planning & Scheduling

Javier Martinez

Critical Constrained Planning and an Application to Network Penetration Testing

Marcel Steinmetz

Human-Robot Communication in Automated Planning

Aleck MacNally

Evening Doctoral consortium dinner

Sunday (June 12, 2016)

ICKEPS: The Fifth International Competition on Knowledge Engineering for Planning and Scheduling

Lukas Chrpá, Lee McCluskey, Mauro Vallati, and Tiago Stegun Vaquero

Sunday: Room K4U.13/14 Monday: Monday (June 13) PM Slot 1, Room K0.20

The International Competition on Knowledge Engineering for Planning and Scheduling (ICKEPS) is a biennial event promoting the development and importance of the use of knowledge engineering methods and techniques within P&S, as well as for providing new interesting benchmarks for the planning community.

The ICKEPS 2016 competition will be held on-site. Specifications of some challenging P&S scenarios and problems will be given out, and competitors will have to produce planning domain models as a solution to the requirements in the specification of the given scenarios. A team of international judges will decide on the merits of each competing team's contribution.

Tutorials

Working with the Planning.Domains API

Christian Muise

Length: Quarter Day

Monday, AM slot 1 Room: S-1.22

This tutorial introduces planning researchers to the basic and advanced features of the Planning.Domains APIs. It is a hands-on session and the attendees are encouraged to bring a laptop computer.

We will cover topics such as the existing (and new) API for the solver and API components, and the API features currently under development for the online editor. Emphasis will be on the latter, because it will enable planning researchers to provide new PDDL analysis and construction tools for the broader community using the editor's upcoming plugin architecture.

No previous experience is required, aside from some basic programming skills to interface with the various APIs. While it is not expected that participants will implement software that uses the APIs fully, the tutorial serves as a foundation for them to begin experimenting. Researchers involved and familiar with the various APIs will also be available throughout the conference to address any questions.

Planning with State-Dependent Action Costs

Robert Mattmüller and Florian Geißer (University of Freiburg, Germany)

Length: Quarter Day

Monday, AM slot 2 Room: S-1.22

With state-dependent action costs, it is possible to represent certain planning tasks exponentially more compactly than without. We discuss how action cost functions can be compactly encoded using edge-valued multi-valued decision diagrams (EVMDDs), how this encoding exhibits additive structure, and how this structure can be exploited, e.g., when computing relaxation or abstraction heuristics. In the theoretical part, we first give an introduction to planning with state-dependent action costs and to EVMDDs, and then show how state-dependent action costs can be compiled away using EVMDDs. Finally, we discuss how EVMDDs can be used to deal with state-dependent action costs directly during the computation of relaxation and abstraction heuristics without compilation. In the practical part, we will look into concrete implementations of EVMDDs and their properties, and we will see a tool that performs the compilation for PDDL inputs.

Multi-Objective Planning under Uncertainty

Shimon Whiteson and Diederik M. Roijers

Length: Two Quarter Day Parts

(Monday, PM slots 1 & 2) Room: S-1.22

Many real-world planning tasks require making decisions that involve multiple possibly conflicting objectives. To succeed in such tasks, intelligent agents need planning algorithms that can efficiently find different ways of balancing the trade-offs that such objectives present. In this tutorial, we provide an introduction to decision-theoretic planning in the presence of multiple objectives.

In part 1, we present an overview of multi-objective decision-theoretic formalisms, with real-world examples. Then, we show that different assumptions about these problems lead to different solution concepts such as the convex hull and the Pareto front.

In part 2, we provide a examples of state-of-the-art planning algorithms. We start with multi-objective variants of dynamic programming for multi-objective Markov decision processes (MOMDPs). Then, we discuss recent work on MOPOMDPs, and discuss point-based planning for MOPOMDPs. We conclude with a brief overview of applications.

Decision Diagrams for Discrete Optimization

John Hooker (Carnegie Mellon University)

Length: Quarter Day

Tuesday, AM slot 1 Room: S-1.22

Decision diagrams have been used for decades as a compact representation of Boolean functions. More recently, they have emerged as a powerful tool for discrete optimization. They provide a discrete relaxation of the problem that does not require linearity or convexity. The relaxation yields useful bounds and a novel search strategy, leading to a general-purpose solver that is competitive with or superior to state-of-the-art integer and constraint programming on several classical benchmark problems. The solver accepts models in the form of a dynamic programming recursion and therefore affords an alternative approach to defeating the curse of dimensionality in dynamic programming.

The specific application to sequencing and scheduling problems will be discussed in the second quarter-day tutorial. Both tutorials are stand-alone presentations.

Decision Diagrams for Sequencing and Scheduling

Willem-Jan van Hoeve (Carnegie Mellon University)

Length: Quarter Day

Tuesday, AM slot 2 Room: S-1.22

The problem of sequencing a set of activities over time is fundamental in planning and scheduling. We discuss how decision diagrams (DDs) can be used to compactly represent a wide range of sequencing problems with various side constraints and objective functions, and we demonstrate how these can be added to existing constraint-based scheduling systems. We show that the additional inference obtained by our DDs can speed up a state-of-the-art solver by several orders of magnitude, over a diverse set of problem classes.

A more general description of the application of DDs to discrete optimization is given in the first quarter-day tutorial. Both tutorials are stand-alone presentations.

Planning Competition for Logistics Robots in Simulation

Tim Niemueller, Erez Karpas, Tiago Vaquero, and Eric Timmons

Length: Half Day

Tuesday, PM slots 1 & 2 Room: K0.20

Robots gain more capabilities every year, yet the use of planning methods to determine the overall behavior is still the exception rather than the norm. A robotics planning competition (in 2017) could foster mutual and closer cooperation between the planning and robotics communities. A first domain could be based on the RoboCup Logistics League in simulation.

This is a half-day tutorial to introduce the scenario, explain how to use the simulation, and characterize the planning domain for potential participants.

Workshops

Heuristics and Search for Domain-independent Planning (HSDIP)

J. Benton, Daniel Bryce, Michael Katz, Nir Lipovetzky, Christian Muise, Miquel Ramirez, and Alvaro Torralba

Monday: room K0.16

Heuristics and search algorithms are the two key components of heuristic search, one of the main approaches to many variations of domain-independent planning, including classical planning, temporal planning, planning under uncertainty and adversarial planning. This workshop seeks to understand the underlying principles of current heuristics and search methods, their limitations, ways for overcoming those limitations, as well as the synergy between heuristics and search. HSDIP-16 will be a part of the ICAPS 2016 conference.

09:00-10:30 Session 1

Correlation Complexity of Classical Planning Domains

Jendrik Seipp, Florian Pommerening, Gabriele Roeger, Malte Helmert

Duality in STRIPS planning

Martin Suda

Improving Performance by Reformulating PDDL into a Bagged Representation

Pat Riddle, Jordan Douglas, Santiago Franco, Michael Barley

Abstraction Heuristics for Symbolic Bidirectional Search

Álvaro Torralba, Carlos Linares Lopez, Daniel Borrajo

10:30-11:00 Coffee Break

11:00-12:30 Session 2

Plan Optimization Based on Windows and Optimization Algorithms Applied in Sequence

Shoma Endo, Masataro Asai, Alex Fukunaga

LTL Synthesis for Non-Deterministic Systems on Finite and Infinite Traces

Alberto Camacho, Eleni Triantafyllou, Christian Muise, Jorge Baier, Sheila McIlraith

Cost-Optimal Algorithms for Hierarchical Goal Network Planning: A Preliminary Report

Vikas Shivashankar, Ron Alford, Mark Roberts, David Aha

12:30-14:00 Lunch

14:00-15:30 Session 3

On State-Dominance Criteria in Fork-Decoupled Search

Álvaro Torralba, Daniel Gnad, Patrick Dubbert, Joerg Hoffmann

Decoupled Strong Stubborn Sets

Daniel Gnad, Martin Wehrle, Joerg Hoffmann

Optimal Solitaire Game Solutions using A* Search and Deadlock Analysis

Gerald Paul, Malte Helmert

15:30-16:00 Coffee break

16:00-17:30 Session 4

Lifting Delete Relaxation Heuristics To Successor Generator Planning

Michael Katz, Dany Moshkovich, Erez Karpas

Blind Search for Atari-like Online Planning Revisited

Alexander Shleyfman, Alexander Tuisov, Carmel Domshlak

Reachability Analysis for Required Concurrency in Temporal Planning

Arthur Bit-Monnot, David Smith, Minh Do

Monte Carlo Tree Search as a Hyper-heuristic Framework for Classical Planning

Otakar Trunda

Planning, Scheduling and Dependability in Safe Human-Robot Interactions (SafePlan)

Ali Shafiti, Kaspar Althoefer, Helge A. Wurdemann, Amedeo Cesta, AndreA Orlandini, and Iñaki Maurtua

Monday: room K0.18

We are pleased to invite you to contribute to this workshop which aims to bring together experts active in the field of planning and scheduling (P&S) with those in human-robot interaction with particular emphasis on safety. The sector experiences a paradigm shift from the traditional heavy-duty robot operating separated from the human worker in a fenced area to robots that work close to the human, adapting to the movements of the human and possibly even interacting with them. In this regard, tools and methodologies for verification and validation (V&V) of P&S systems have received relatively little attention. Therefore, important goals of the workshop are also to focus on interactions between P&S and V&V communities as well as to identify innovative V&V tools and methodologies when applied to P&S in human-robot collaboration scenarios.

9:00-9:30 Welcome & FourByThree Introduction

Keynote 'Sharing spaces: planning and learning for interactions between robots and humans'

Jeremy Wyatt

10:30-11:00 Coffee Break

11:00-12:30 Session 1

Invited Talk 'A Human-Robot Interaction-Planning Framework for Task Allocation in Collaborative Industrial Assembly Processes'

Sami Haddadin

Nested Safety Sets for Collision Avoidant Human-Robot Systems

K. Hawkins and H. Christensen

Real-Time Obstacle Avoidance for Continuum Manipulator: Towards Safer Application in Human Environments

Ahmad Ataka, Ali Shafiti, Ali Shiva, Helge Wurdemann and Kaspar Althoefer

Invited Talk 'Teaching Robots to Do Our Chores via Safe and Natural Human-Robot Interaction'

Petar Kormushev

12:30-14:00 Lunch Break

14:00-15:30 Session 2

Invited Talk 'Challenges in extending learning from demonstration to collaborative robots'

Sylvain Calinon

Demonstration of Complex Task Execution using Basic Functionalities: Experiences with the Mobile Assistance Robot, "ANNIE"

Christoph Walter, Schulenburg Erik, Jose Saenz, Felix Penzlin and Norbert Elkmann

Interacting with collaborative robots in industrial environments: A semantic approach

Iñaki Maurtua, Izaskun Fernandez, Johan Kildal, Loreto Susperregi, Alberto Tellaeche and Aitor Ibarguren

Invited Talk 'Can we use robot skin to enable a dependable human-robot cooperation?'

Fulvio Mastrogiovanni

15:30-16:00 Coffee Break

Workshops

16:00-17:30 Session 3

Invited Talk 'Automated Planning and Verification - A Never-Ending Story'

Daniele Magazzeni

Dynamic Task Planning for Safe Human Robot Collaboration

Amedeo Cesta, Giulio Bernardi, AndreA Orlandini, Alessandro Umbrico

Round Table Discussion

Workshops

Planning and Robotics (PlanRob)

Alberto Finzi and Erez Karpas

Monday: all day, room K2.40 Tuesday: morning, room K0.20

Robotics is one of the most appealing and natural applicative area for the Planning and Scheduling (P&S) research activity, however such a natural interest seems not reflected in an equally important research production for the Robotics community. In this perspective, the aim of the PlanRob workshop is twofold. On the one hand, this workshop would constitute a fresh impulse for the ICAPS community to develop its interests and efforts towards this challenging research area. On the other hand, it aims at attracting representatives from the Robotics community to discuss their challenges related to planning for autonomous robots (deliberative, reactive, continuous planning and execution etc.) as well as their expectations from the P&S community. The PlanRob workshop aims at constituting a stable, long-term forum on relevant topics concerned with the interactions between the Robotics and P&S communities where researchers could discuss the opportunities and challenges of P&S when applied to Robotics. Started during ICAPS 2013 in Rome (Italy) and followed by a second edition at ICAPS 2014 in Portsmouth (NH, USA) and a third one at ICAPS 2015 in Jerusalem (Israel), the PlanRob WS series (<http://pst.istc.cnr.it/planrob/>) has gathered very good feedback from the P&S community which is also confirmed by the organisation of a specific Robotics Track from ICAPS 2014.

Monday

09:00-10:30 Session 1: High Level Planning for Robots

Welcome

Planning for Robots with Skills

Matthew Crosby, Francesco Rovida, Mikkel Rath Pedersen, Ron Petrick and Volker Krueger

Autonomous Search by a Socially Assistive Robot in a Residential Care Environment for Multiple Elderly Users Using Group Activity Preferences

Sharaf Mohamed and Goldie Nejat

Strategic Planning for Autonomous Systems over Long Horizons

Michael Cashmore, Maria Fox, Derek Long, Daniele Magazzeni and Bram Ridder

Opportunistic Planning for Increased Plan Utility

Michael Cashmore, Maria Fox, Derek Long, Daniele Magazzeni and Bram Ridder

10:30-11:00 Coffee Break

11:00-12:30 Session 2: Invited Talk + Challenge

Planning Competition for Logistics Robots in Simulation

Tim Niemueller, Erez Karpas, Tiago Vaquero and Eric Timmons

Invited Talk: The Multiple Facets of Planning in Robot Autonomy

Manuela Veloso

12:30-14:00 Lunch

14:00-15:30 Session 3: Goal Reasoning + Task & Motion Planning

Spatio-Temporal Planning for a Reconfigurable Multi-Robot System

Thomas Roehr

Goal Reasoning with Informative Expectations

Benjamin Johnson, Mark Roberts, David W. Aha and Thomas Apker

Goal Reasoning, Planning, and Acting with ActorSim, The Actor Simulator

Mark Roberts, Ron Alford, Vikas Shivashankar, Michael Leece, Shubham Gupta and David Aha

Scheduling Pick-and-Place Tasks for Dual-arm Manipulators using Incremental Search on Coordination Diagrams

Andrew Kimmel and Kostas Bekris

Sequential Quadratic Programming for Task Plan Optimization

Christopher Lin, Dylan Hadfield-Menell, Rohan Chitnis, Stuart Russell and Pieter Abbeel

Workshops

15:30-17:00 Coffee Break + Poster Session

Session 4: Space & Marine Robotics

Path Planning for Unmanned Vehicles Operating in Time-Varying Flow Fields

Brual Shah, Petr Svec, Atul Thakur and Satyandra Gupta

Evaluating the Impact of Model Accuracy in Batch and Continuous Planning for Control of Marine Floats

Martina Troesch, Steve Chien, Yi Chao and John Farrara

Productivity Challenges for Mars Rover Operations

Daniel Gaines, Robert Anderson, Gary Doran, William Huffman, Heather Justice, Ryan Mackey, Gregg Rabideau, Ashwin Vasavada, Vandana Verma, Tara Estlin, Lorraine Fesq, Michel Ingham, Mark Maimone and Issa Nesnas

Risk-aware Planning Executive for Autonomous Underwater Gliders

Eric Timmons, Tiago Vaquero, Brian Williams and Richard Camilli

Tuesday

09:00-10:30 Session 5: Learning, Planning, and Monitoring

Welcome Day 2

Online Reinforcement Learning for Real-Time Exploration in Continuous State and Action Markov Decision Processes

Ludovic Hofer and Hugo Gimbert

Discovering Domain Axioms Using Relational Reinforcement Learning and Declarative Programming

Mohan Sridharan, Venkata Devarakonda and Rashmica Gupta

Instinct: A Biologically Inspired Reactive Planner for Embedded Environments

Robert Wortham, Swen Gaudl and Joanna Bryson

Planning and Monitoring with Performance Level Profiles

Maor Ashkenazi, Michael Bar-Sinai and Ronen Brafman

10:30-11:00 Coffee Break

11:00-12:30 Session 6: Path & Motion Planning

Intention-Aware Motion Planning Using Learning Based Human Motion Prediction

Jae Sung Park, Chonhyon Park and Dinesh Manocha

From videogames to autonomous trucks: A new algorithm for lattice-based motion planning

Marcello Cirillo

A Bayesian Effort Bias for Sampling-based Motion Planning

Scott Kiesel and Wheeler Ruml

Risk-averse path planning with observation options

Aino Ropponen, Mikko Lauri and Risto Ritala

A Risk-Based Framework for Incorporating Navigation Uncertainty Into Exploration Strategies

Jason Gregory, Jonathan Fink, John Rogers and Satyandra Gupta

Closing Discussion

Workshops

Scheduling and Planning Applications woRKshop (SPARK)

Sara Bernardini, Steve Chien, Shirin Sohrabi and Simon Parkinson

Tuesday: room K0.18

Application domains that contain planning and scheduling (P & S) problems pose a combination of issues, from modelling to technological to institutional, that present challenges to the AI planning and scheduling community. New domains and real-world problems are becoming increasingly affordable for AI. The international Scheduling and Planning Applications woRKshop (SPARK) series was established to help address the gap between developments in the AI P & S community and application of these advances.

08:50-10:30 Session 1: Space

Managing Spacecraft Memory Buffers with Overlapping Store and Dump Operations

Gregg Rabideau, Steve Chien, Federico Nespoli and Marc Costa

Using Operations Scheduling to Optimize Constellation Design

Steve Schaffer, Andrew Branch, Steve Chien, Stephen Broschart, Sonia Hernandez, Konstantin Belov, Joseph Lazio, Loren Clare, Philip Tsao, Julie Castillo-Rogez and E. Jay Wyatt

TIAGO – Tool for Intelligent Allocation of Ground Operations on Cluster-II

Simone Fratini, Nicolas Faerber, Nicola Policella and Bruno Teixeira De Sousa

Prioritization and Oversubscribed Scheduling for NASA's Deep Space Network

Caroline Shouraboura, Mark Johnston and Daniel Tran

10:30-11:00 Coffee Break

11:00-12:15 Session 2: Security & Web

Efficient High Quality Plan Exploration for Network Security

Anton Riabov, Shirin Sohrabi, Octavian Udrea and Oktie Hassanzadeh

Constructing Plan Trees for Simulated Penetration Testing

Guy Shani, Joerg Hoffmann, Dorin Shmaryahu and Marcel Steinmetz

Automatic Resolution of Policy Conflicts in IoT Environments Through Planning

Emre Goynugur, Kartik Talamadupula, Geeth De Mel and Murat Sensoy

12:15-13:50 Lunch

13:50-14:40 Session 3: Marine

Evaluating Scientific Coverage Strategies for A Heterogeneous Fleet of Marine Assets Using a Predictive Model of Ocean Currents

Andrew Branch, Martina Troesch, Steve Chien, Yi Chao, John Farrara and Andrew Thompson

Planning Autonomous Underwater Reconnaissance Operations

Sara Bernardini, Maria Fox, Derek Long and Bram Ridder

14:40-15:30 Session 4: Natural Language & Biology

Search Challenges in Natural Language Generation with Complex Optimization Objectives

Vera Demberg, Joerg Hoffmann, David M. Howcroft, Dietrich Klakow and Álvaro Torralba

Exploring Organic Synthesis with State-of-the-Art Planning Techniques

Rami Matloob and Mikhail Soutchanski

15:30-16:00 Coffee Break

Workshops

16:00-17:15 Session 5: Requirement Analysis & Manufacturing

Deploying a Schedule Optimization Tool for Vehicle Testing

Jeremy Ludwig, Annaka Kalton, Robert Richards, Brian Bautsch, Craig Markusic and Cyndi Jones

Planning Machine Activity Between Manufacturing Operations: Maintaining Accuracy While Reducing Energy Consumption

Simon Parkinson, Andrew Longstaff, Simon Fletcher, Mauro Vallati and Lukas Chrpa

Using Hierarchical Models for Requirement Analysis of Real World Problems in Automated Planning

Rosimarci Tonaco-Basbaum, Javier Silva and Reinaldo Silva

Workshops

Distributed and Multi-Agent Planning (DMAP)

Antonín Komenda, Guy Shani, Roni Stern, Dániel Laszlo Kovacs and Chris Amato

Tuesday: room K0.16

Multi-agent planning is a broad field with many applications, but its subfields remain mostly dispersed and un-coordinated. The main goal of the 4th Workshop on Distributed and Multi-Agent Planning (DMAP), as in the previous editions, is to bring researchers working in these subfields together and to bridge the gap between the planning and multi-agent systems communities. DMAP-16 will be a part of the ICAPS 2016 conference.

08:45 Welcome

9:00-9:40 Session 1: Theory

Better Eager Than Lazy? How Agent Types Impact the Successfulness of Implicit Coordination

Thomas Bolander, Thorsten Engesser, Robert Mattmüller and Bernhard Nebel

Generating Collaborative Behaviour through Plan Recognition and Planning

Christopher Geib, Bart Craenen and Ron Petrick

9:40-10:30 Session 2: MAP

Trial-based Heuristic Tree-search for Distributed Multi-Agent Planning

Tim Schulte and Bernhard Nebel

A Distributed Online Multi-Agent Planning System

Rafael C. Cardoso and Rafael H. Bordini

10:30-11:00 Coffee break

11:00-11:40 Session 3: Path planning

Multi-Agent Route Planning Using Delegate MAS

Hoang Tung Dinh, Rinde R.S. van Lon and Tom Holvoet

Efficient SAT Approach to Multi-Agent Path Finding under the Sum of Costs Objective

Pavel Surynek, Ariel Felner, Roni Stern and Eli Boyarski

11:40-12:30 Invited talk:

Multirobot Coordination: From High-level Specification to Correct Execution by Nora Ayanian

12:30-14:00 Lunch

14:00-15:00 Session 4: Applications

Factored Monte-Carlo Tree Search for Coordinating UAVs in Disaster Response

Chris A. B. Baker, Sarvapali Ramchurn, Luke Teacy and Nick Jennings

A Game Theoretical Formulation of a Decentralized Cooperative Multi-Agent Surveillance Mission

Paulo Eduardo Ubaldino de Souza, Caroline Ponzoni Carvalho Chanel and Sidney Givigi

Hierarchical Planning with Traffic Zones for a Team of Industrial Transport Robots

Stefan Imlauer, Clemens Mühlbacher, Gerald Steinbauer, Michael Reip and Stephan Gspandl

15:00-15:20 Session 5: Theory

Automated Verification of Social Law Robustness in STRIPS

Erez Karpas, Alexander Shleyfman and Moshe Tennenholtz

15:30-16:00 Coffee break

Workshops

16:00-17:20 Session 6: Privacy

Quantifying Privacy Leakage in Multi-Agent Planning

Michal Štolba, Jan Tožička and Antonín Komenda

How to Compute Multi-Agent Heuristics Additively

Michal Štolba and Antonín Komenda

Increased Privacy with Reduced Communication and Computation in Multi-Agent Planning

Shlomi Maliah, Guy Shani and Ronen Brafman

Privacy Preserving LAMA

Shlomi Maliah, Guy Shani and Roni Stern

Workshops

Constraint Satisfaction techniques for planning and Scheduling (COPLAS)

Miguel A. Salido and Roman Barták

Tuesday afternoon: room S-1.22

The workshop aims at providing a forum to discuss novel issues on planning, scheduling, and constraint satisfaction problems. Solutions to many real-world problems need to integrate plan synthesis capabilities with time and resource allocation, which can be efficiently managed by constraint satisfaction and OR techniques. Formulations of P&S problems as CSPs, resource and temporal global constraints, and inference techniques are of particular interest of COPLAS.

14:00-15:30 Session 1: Scheduling

A multi-objective memetic algorithm for solving job shops with a non-regular energy cost

Miguel Á. González, Angelo Oddi, Riccardo Rasconi

Job Shop Scheduling Solver based on Quantum Annealing

Davide Venturelli, Dominic Marchand, Galo Rojo

Assesment of a multi agent system for energy aware off-line scheduling from a real case manufacturing data set

Giancarlo Nicolò, Miguel A. Salido, Adriana Giret, Federico Barber

15:30-16:00 Coffee break

16:00-17:00 Session 2: Planning

A CASP-Based Approach to PDDL+ Planning

Marcello Balduccini, Daniele Magazzeni, Marco Maratea

Mixed-integer and Constraint Programming Techniques for Mobile Robot Task Planning

Kyle E. C. Booth, Tony T. Tran, Goldie Nejat, J. Christopher Beck

Detailed Schedule - Wednesday (June 15, 2016)

08:20 Opening Remarks (room: Edmund J Safra)

08:30 Invited Talk - David Silver: 'Mastering the Game of Go with Deep Neural Networks and Tree Search' (room: Edmund J Safra)

09:30-09:35 Break

Classical Planning (Session 1a)

Room: Edmund J Safra Time: 09:35-10:50
Session Chair: Joerg Hoffmann

An Analysis of Merge Strategies for Merge-and-Shrink Heuristics (short)

Sievers, S.; Wehrle, M.; and Helmert, M

Abstractions for Planning with State-Dependent Action Costs

Geißer, F.; Keller, T.; and Mattmüller, R

Traps, Invariants, and Dead-Ends (short)

Lipovetzky, N.; Muise, C.; and Geffner, H

Recursive Polynomial Reductions for Classical Planning

Tozicka, J.; Jakubuv, J.; and Komenda, A

Distributed and Multi-Agent Planning (Session 1b)

Room: Great Hall Time: 09:35-10:50
Session Chair: Sven Koenig

Stronger Privacy Preserving Projections for Multi-Agent Planning (short/robotics)

Shani, G.; Maliah, S.; and Stern, R

Potential Heuristics for Multi-Agent Planning

Štolba, M.; Fišer, D.; and Komenda, A

Online Macro Generation for Privacy Preserving Planning (short)

Shani, G.; Brafman, R.; and Maliah, S

Online Learning of Robot Soccer Free Kick Plans using a Bandit Approach

Mendoza, J. P.; Simmons, R.; and Veloso, M

10:50-11:10 Coffee Break (Great Hall)

Probabilistic/Stochastic Reasoning (Session 2a)

Room: Edmund J Safra Time: 11:10-12:20
Session Chair: Alan Fern

OGA-UCT: On the Go Abstractions in UCT

Anand, A.; Noothigattu, R.; Mausam; and Singla, P

Revisiting Goal Probability Analysis in Probabilistic Planning

Steinmetz, M.; Hoffmann, J.; and Buffet, O

Leveraging Probabilistic Reasoning in Deterministic Planning for Large-Scale Autonomous Search-and-Tracking

Bernardini, S.; Fox, M.; Long, D.; and Piacentini, C

Path Planning (Session 2b)

Room: Great Hall Time: 11:10-12:20
Session Chair: Sven Koenig

Path Planning under Interface-Based Constraints for Shared Human-Robot Control (robotics)

Broad, A.; and Argall, B

A Unifying Formalism for Shortest Path Problems with Expensive Edge Evaluations via Lazy Best-First Search over Paths with Edge Selectors (robotics)

Dellin, C.; and Srinivasa, S

Speeding up A* Search on Visibility Graphs Defined Over Quadrees to Enable Long Distance Path Planning for Unmanned Surface Vehicles (robotics)

Shah, B.; and Gupta, S. K

12:20-13:50 Lunch

Detailed Schedule - Wednesday (June 15, 2016)

Planning and Scheduling for Exploration (Session 3a)

Room: Edmund J Safra Time: 13:50-15:00
Session Chair: David E. Smith

Scheduling Ocean Color Observations for a GEO-Stationary Satellite (application)

Frank, J.; Do, M.; and Tran, T

Planning and control of marine floats in the presence of dynamic, uncertain currents (application)

Troesch, M.; Chien, S.; Chao, Y.; and Farrara, J

Strategic Planning for Setting up Base Stations in Emergency Medical Systems (application)

Ghosh, S.; and Varakantham, P

Distributed and Multi-Agent Systems (Session 3b)

Room: Great Hall Time: 13:50-15:00
Session Chair: Ronen Brafman

Evaluation of Auction-Based Multi-Robot Routing by Parallel Simulation (robotics)

Kishimoto, A.; and Nagano, K

Multi-Agent Sensor Data Collection with Attrition Risk

Hudack, J.; and Oh, J

A Formal Analysis of Required Cooperation in Multi-agent Planning

Zhang, Y.; Sreedharan, S.; and Kambhampati, S

15:00-15:20 Coffee Break (Great Hall)

Domain Model Acquisition (Session 4a)

Room: Edmund J Safra Time: 15:20-16:05
Session Chair: Lee McCluskey

Domain Model Acquisition in Domains with Action Costs

Gregory, P.; and Lindsay, A

Learning Relational Dynamics of Stochastic Domains for Planning

Martínez, D.; Ribeiro, T.; Inoue, K.; Alenya, G.; and Torras, C

Learning for Robot Control (Session 4b)

Room: Great Hall Time: 15:20-16:05
Session Chair: Alberto Finzi

Experience-Based Robot Task Learning and Planning with Goal Inference (robotics)

Mokhtari, V.; Lopes, L. S.; and Pinho, A. J

Real-Time Stochastic Optimal Control for Multi-agent Quadrotor Systems (robotics)

Gómez, V.; Thijssen, S.; Symington, A.; Hailes, S.; and Kappen, B

16:05 Competition Results (Edmund J Safra)

16:50-17:00 Break

17:00-19:00 Poster Sessions and System Demos

WEDNESDAY

Thursday (June 16, 2016)

08:30 Invited Talk - Susanne Biundo: 'Making Plans for Human Users' (room: Edmund J Safra)

09:30-09:35 Break

Planning under Uncertainty and with Incomplete Knowledge (Session 5a)

Room: Edmund J Safra Time: 09:35-10:50

Session Chair: Florent Teichteil-Königsbuch

Heuristic Guidance for Forward-Chaining Planning with Numeric Uncertainty (short)

Marinescu, L.; and Coles, A

From FOND to Robust Probabilistic Planning: Computing compact policies that bypass avoidable deadends (short)

Camacho, A.; Muise, C.; and McIlraith, S

Robot task planning and explanation in open and uncertain worlds (journal)

Marc Hanheide, Moritz Gobelbecker, Graham Horn, Andrzej Pronobis, Kristoffer Sjøo, Alper Aydemir, Patric Jensfelt, Charles Gretton, Richard Dearden, Miroslav Janicek, Geert-Jan Kruijff, Nick Hawes, Jeremy Wyatt

Generalized Planning With Procedural Domain Control Knowledge

Segovia, J.; Jimenez, S.; and Jonsson, A

Motion Planning (Session 5b)

Room: Great Hall Time: 09:35-10:50

Session Chair: Federico Pecora

Task and Motion Policy Synthesis as Liveness Games (short/robotics)

Wang, Y.; Dantam, N.; Chaudhuri, S.; and Kavraki, L.

Strict Theta*: Shorter Motion Path Planning using Taut Paths (short/robotics)

Oh, S.; and Leong, H. W

Robust Allocation of RF Device Capacity for Distributed Spectrum Functions (journal)

Stephen F. Smith, Zachary B. Rubinstein, David Shur, John Chapin

Robot Motion Planning for Pouring Liquids (robotics)

Pan, Z.; Park, C.; and Manocha, D

10:50-11:10 Coffee Break (Great Hall)

Hybrid Planning (Session 6a)

Room: Edmund J Safra Time: 11:10-12:20

Session Chair: Scott Sanner

A Semantic Notion of Interference for Planning Modulo Theories

Bofill, M.; Arxer, J. E.; and Villaret, M

Numeric Planning with Disjunctive Global Constraints via SMT

Scala, E.; Ramírez, M.; Haslum, P.; and Thiebaux, S

A Compilation of the Full PDDL+ Language into SMT

Cashmore, M.; Fox, M.; Long, D.; and Magazzeni, D

Business and Manufacturing Applications (Session 6b)

Room: Great Hall Time: 11:10-12:20

Session Chair: Tiago Vaquero

Cell Design and Routing of Jobs in a Multisite Make-to-Order Enterprise (application)

Gupta, M.; P, J. C. B. R.; and Dutta, P

A Planning-based Architecture for a Reconfigurable Manufacturing System (application)

Borgo, S.; Cesta, A.; Orlandini, A.; and Umbrico, A

Computing Trace Alignment against Declarative Process Models through Planning (application)

Giacomo, G. D.; Maggi, F. M.; Marrella, A.; and Sardina, S

12:20-13:50 Lunch

Outstanding Papers (Session 7): Plenary

Room: Edmund J Safra

Time: 13:50-15:20

Heuristic Search in Dual Space for Constrained Stochastic Shortest Path Problems

Trevizan, F.; Thiebaux, S.; Santana, P.; and Williams, B

Practical Undoability Checking via Contingent Planning

Daum, J.; Torralba, Á.; Hoffmann, J.; Haslum, P.; and Weber, I

Multi-Agent Path Finding with Kinematic Constraints (robotics)

Hoenig, W.; Kumar, T. K. S.; Cohen, L.; Ma, H.; Xu, H.; Ayanian, N.; and Koenig, S

Optimal Scheduling of a Constellation of Earth-Imaging Satellites, for Maximal Data

Throughput and Efficient Human Management (application)

Augenstein, S.; Estanislao, A.; Guere, E.; and Blaes, S

15:20-15:40 Coffee Break (Great Hall)

ICAPS Awards: Plenary

Room: Edmund J Safra

Time: 15:40-16:45

Presentation of Awards

ICAPS President

Best dissertation award winner: 'Planning Techniques and the Action Language Golog'

Röger, G.

Honourable mention: 'Experience Graphs: Leveraging Experience in Planning'

Phillips, M.

Honourable mention: 'Symbolic Search and Abstraction Heuristics for Cost-Optimal Planning'

Torralba, A.

Most Influential Paper: 'A Planning Heuristic Based on Causal Graph Analysis', ICAPS 2004

Helmert, M.

16:45 Community Meeting (Edmund J Safra)

17:40 Depart for Conference Banquet

Friday (June 17, 2016)

08:30 **Invited Talk - Stephen Smith: 'Real-time Planning for Real-Time Traffic Control' (The Great Hall)**

09:30-09:35 **Break**

Temporal and Numeric Planning (Session 8a)
Room: Great Hall Time: 09:35-10:50
Session Chair: Sylvie Thiébaux

Symbolic discrete-time planning with continuous numeric action parameters for agent-controlled processes (journal)

Florian Pantke, Stefan Edelkamp, Otthein Herzog

Have I Been Here Before? State Memoization in Temporal Planning

Coles, A.; and Coles, A

Planning Curtailment of Renewable Generation in Power Grids (short/application)

Bandyopadhyay, S.; Kumar, P.; and Arya, V

Solving Realistic Unit Commitment Problems using Temporal Planning: Challenges and Solutions (application)

Piacentini, C.; Magazzeni, D.; Long, D.; Fox, M.; and Dent, C

Planning and Execution (Session 8b)
Room: K1.28 Time: 09:35-10:50
Session Chair: AndreA Orlandini

A robot sets a table: a case for hybrid reasoning with different types of knowledge (journal)

Mansouri, M and Pecora, F.

Integrating Planning and Control for Efficient Path Planning in the Presence of Environmental Disturbances (robotics)

Aine, S.; and Pb, S

A Systematic Analysis of Levels of Integration between High-Level Task Planning and Low-Level Feasibility Checks (journal)

Esra Erdem, Volkan Patoglu and Peter Schüller

A practical framework for robust decision-theoretic planning and execution for service robots (robotics)

Iocchi, L.; Jeanpierre, L.; Lázaro, M. T.; and Abdel-Ilhah, M

10:50-11:10 **Coffee Break (Chapters)**

Search (Session 9a)
Room: Great Hall Time: 11:10-12:20
Session Chair: Wheeler Ruml

Search Portfolio with Sharing

Aine, S.; and Likhachev, M

Efficient Representation of Pattern Databases Using Acyclic Random Hypergraphs

Sadeqi, M.; and Hamilton, H

Automated Creation of an Efficient Work Distribution Method for Parallel Best-First Search

Jinnai, Y.; and Fukunaga, A

Time and Uncertainty (Session 9b)
Room: K1.28 Time: 11:10-12:20
Session Chair: Steve Smith

Checking the Dynamic Consistency of Conditional Simple Temporal Networks with Bounded Reaction Times

Hunsberger, L.; and Posenato, R

PARIS: a Polynomial-time, Risk-Sensitive Scheduling Algorithm for Probabilistic Simple Temporal Networks with Uncertainty

Santana, P.; Vaquero, T.; Toledo, C.; Wang, A.; Fang, C.; and Williams, B

Robust Partial Order Schedules for RCPSP/max with Durational Uncertainty

Fu, N.; Varakantham, P.; and Lau, H. C

12:20-13:50 **Lunch**

Friday (June 17, 2016)

Planning Effective Resource Placement (Session 10a)

Room: Great Hall

Time: 13:50-15:00

Session Chair: Neil Yorke-Smith

Placement of Loading Stations for Electric Vehicles: Allowing Small Detours

Funke, S.; Nusser, A.; and Storandt, S

Towards Next Generation Touring: Personalized Group Tours (application)

Lim, K. H.; Chan, J.; Leckie, C.; and Karunasekera, S

More Shuttles, Less Cost: Energy Efficient Plan- ning for Scalable High-Density Warehouse Environ- ments (application)

Hütter, C

15:00-15:20 **Coffee Break (Chapters)**

POMDP/MDP (Session 11a)

Room: Great Hall

Time: 15:20-16:50

Session Chair: Felipe Trevizan

Dual Formulations for Optimizing Dec-POMDP Controllers

Kumar, A.; Mostafa, H.; and Zilberstein, S

Optimal Cost Indefinite-Horizon Reachability in Goal DEC-POMDPs

Chatterjee, K.; and Chmelík, M

Hierarchical Linearly-Solvable Markov Decision Problems

Jonsson, A.; and Gómez, V

Bayesian Optimization with Resource Constraints and Production

Dolatnia, N.; Fern, A.; and Fern, X

16:50 **Closing Remarks (The Great Hall)**

Scheduling (Session 10b)

Room: K1.28

Time: 13:50-15:00

Session Chair: Chris Beck

Online Algorithms for the Linear Tape Scheduling Problem

Cardonha, C.; and Real, L. V

The Mathematics of Dispatchability Revisited

Morris, P

Algebraic Differential Evolution Algorithm for the Permutation Flowshop Scheduling Problem with Total Flowtime Criterion (journal)

Alfredo Milani, Valentino Santucci, Marco Baiocchi

Complexity (Session 11b)

Room: K1.28

Time: 15:20-16:50

Session Chair: Malte Helmert

Assessing the Expressivity of Planning Formalisms through the Comparison to Formal Languages

Höller, D.; Behnke, G.; Bercher, P.; and Biundo, S

Change the Plan - How hard can that be?

Behnke, G.; Höller, D.; Bercher, P.; and Biundo, S

Bound to Plan: Exploiting Classical Heuristics via Automatic Translations of Tail-Recursive HTN Problems

*Alford, R.; Behnke, G.; Höller, D.; Bercher, P.; Biundo, S.;
and Aha, D*

A Multi-parameter Complexity Analysis of Cost- optimal and Net-benefit Planning

Aghighi, M.; and Bäckström, C

