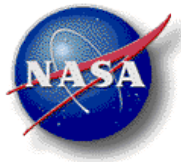
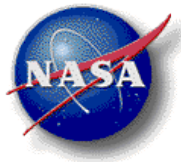


User Interfaces and Scheduling and Planning (UISP): Workshop Summary and Proposed Challenges

Rick Freedman (University of Massachusetts Amherst)
Tathagata Chakraborti (Arizona State University)
Kartik Talamadupula (IBM Research)
Daniele Magazzeni (Kings College London)
Jeremy Frank (NASA Ames Research Center)



Outline

- Automated Planning and Scheduling (APS)
- APS and User Interfaces (UIs)
- 2017 UISP Workshop Overview
  - Papers
  - Invited talks
  - Panel
- Engaging Other Communities!

Automated Planning and Scheduling

- "*Planning is the art and practice of Thinking before Acting*." – P. Haslum
- "*Planning is selecting a goal-leading course of action based on a high-level description of the world*." – J. Hoffmann
- A major subfield of AI

IJCAI - ECAI 2018

July 13-19, 2018
Stockholm
Sweden

EurAi

icaps

The AAAI Conference on Artificial Intelligence

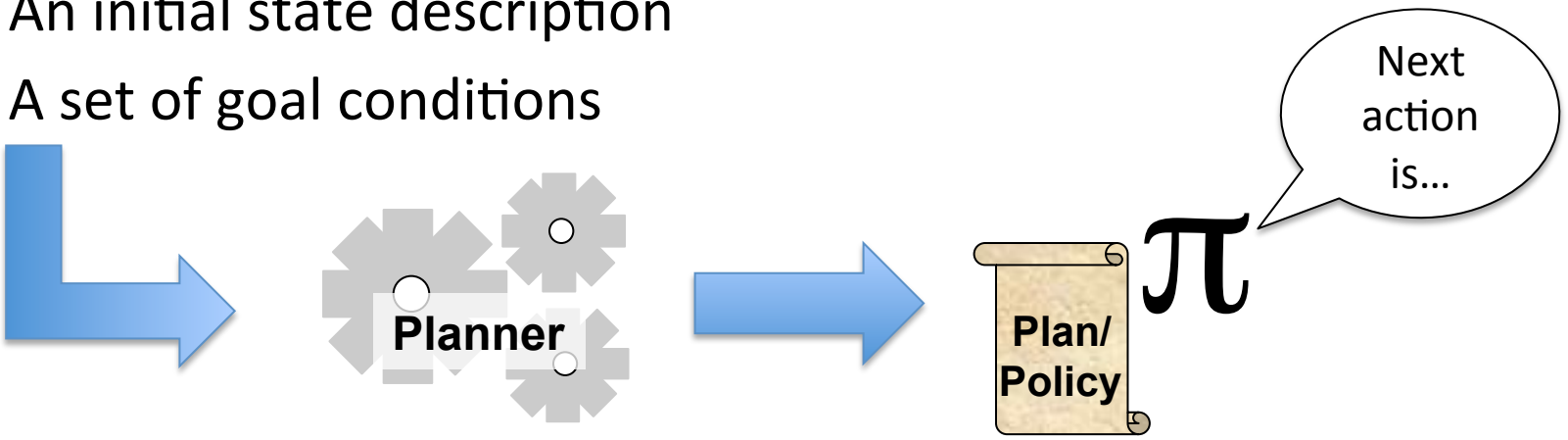
Artificial Intelligence

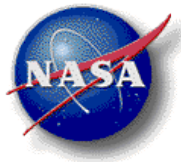
Journal of Artificial Intelligence Research

Journal of SCHEDULING

Automated Planning and Scheduling

- A planning *model* consists of:
  - Objects – things in the world
  - Predicates and Functions – properties of objects
  - Actions – ways of changing the properties
- A planning *problem* consists of:
  - A model
  - An initial state description
  - A set of goal conditions

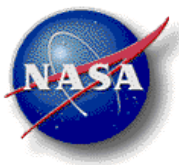


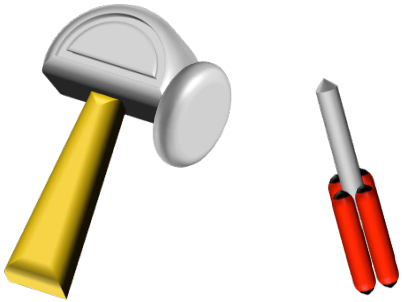


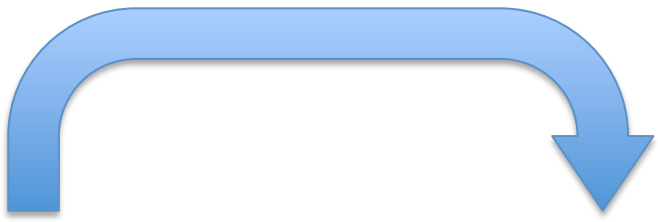
APS and UIs

We solicited papers and participation in this workshop to discuss the following themes:

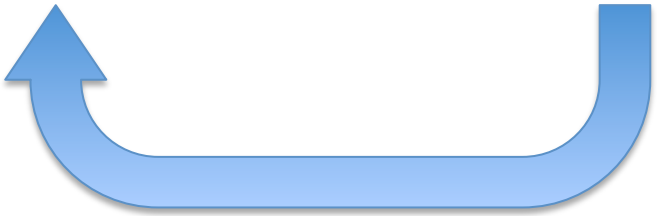
- UIs for Planning and Scheduling Systems
- Planning and Scheduling to build better UIs
- Emerging UI technology – Brainstorm and Innovate

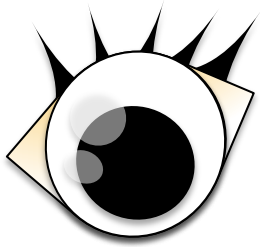






APS UIs

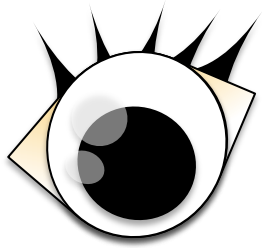




APS and UIs

UIs for Planning and Scheduling Systems:

- Increase usability of APS technology
  - Tools for model and problem development
  - Tools to visualize plans

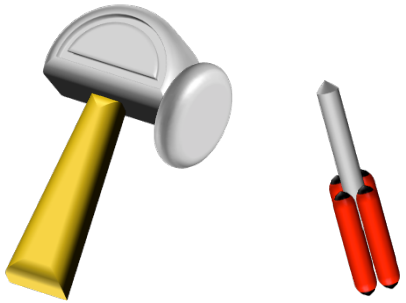


- Stimulate UI-related automated planning research in the APS community

APS and UIs

APS techology for building better UIs:

- APS technology to build UI workflows

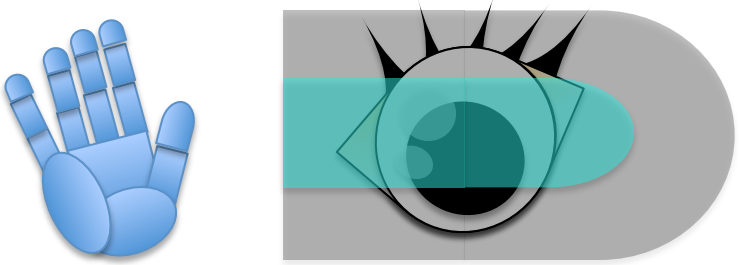


- Automated reasoning systems to generate UIs
- Adapt user experience via decisions based on user actions

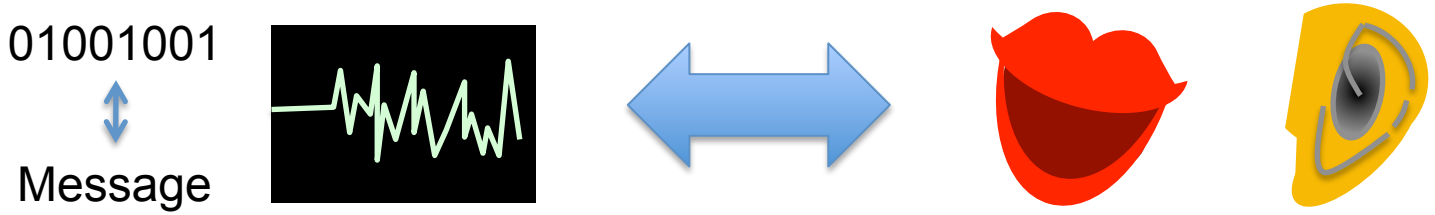
APS and UIs

Potenital for emerging UI technology in APS:

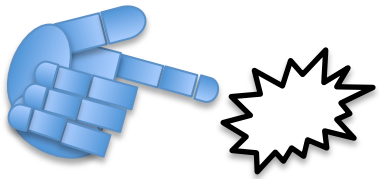
- Virtual and/or Augmented Reality



- Natural Language Processing



- Haptics



ICAPS 2017 UISP Workshop

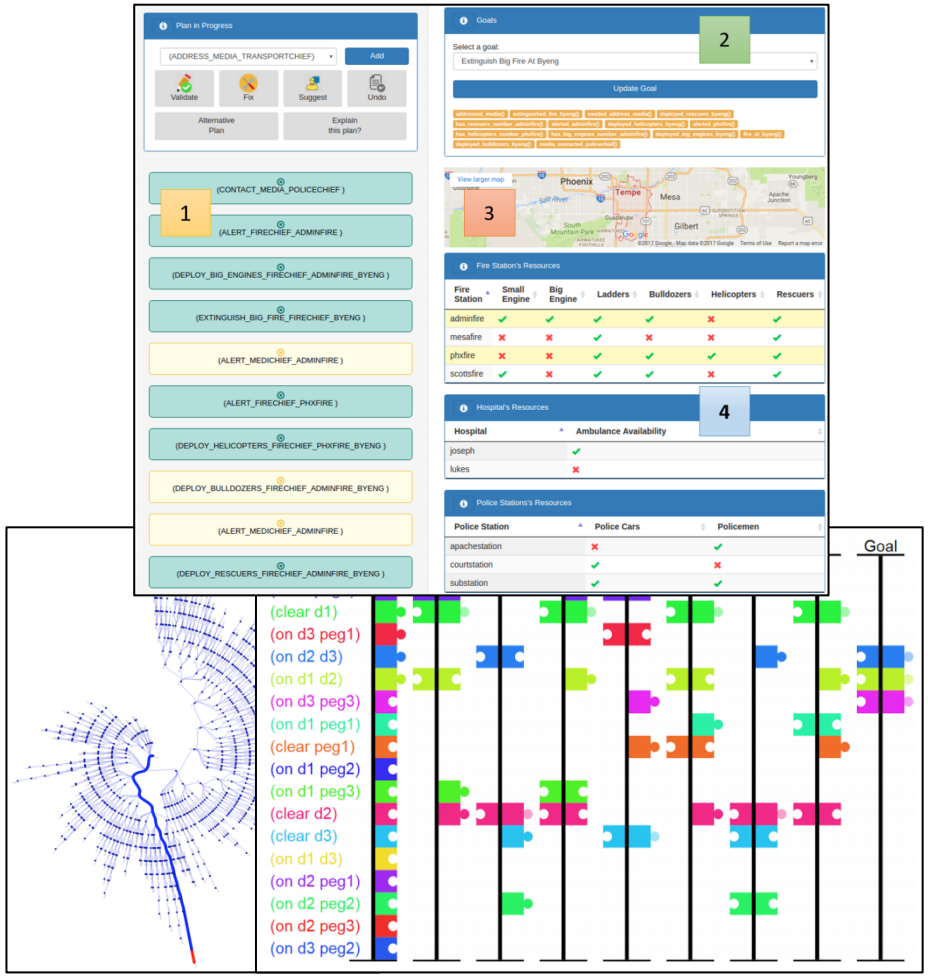
- 8 papers
  - 6 long, 2 short
- 2 invited talks
  - 1 academic, 1 industry
- 1 panel
  - Mix of perspectives
- Discussion
  - What next?

http://icaps17.icaps-conference.org/workshops/UISP/

Paper ↓ / Feature →	GUI	NL	MR	BCI	BE	Synthesis	Execution	Modeling	Visualization	Mixed-Initiative
PRIDE-AVR	✓	✗	✓	✗	✗	✗	✓	✓	✓	✗
CRADLE	✗	✗	✗	✗	✓	✓	✓	✗	✗	✗
WEB PLANNER	✓	✗	✗	✗	✗	✓	✗	✓	✓	✗
Conductor	✓	✗	✗	✗	✗	✓	✗	✓	✓	✗
CHAP-E	✓	✗	✗	✗	✗	✓	✓	✗	✓	✗
RADAR	✓	✗	✗	✗	✗	✓	✗	✗	✓	✓
Æffective	✗	✗	✓	✓	✗	✗	✓	✓	✓	✗
Complexity Metrics	✗	✗	✗	✗	✓	✗	✗	✓	✗	✗

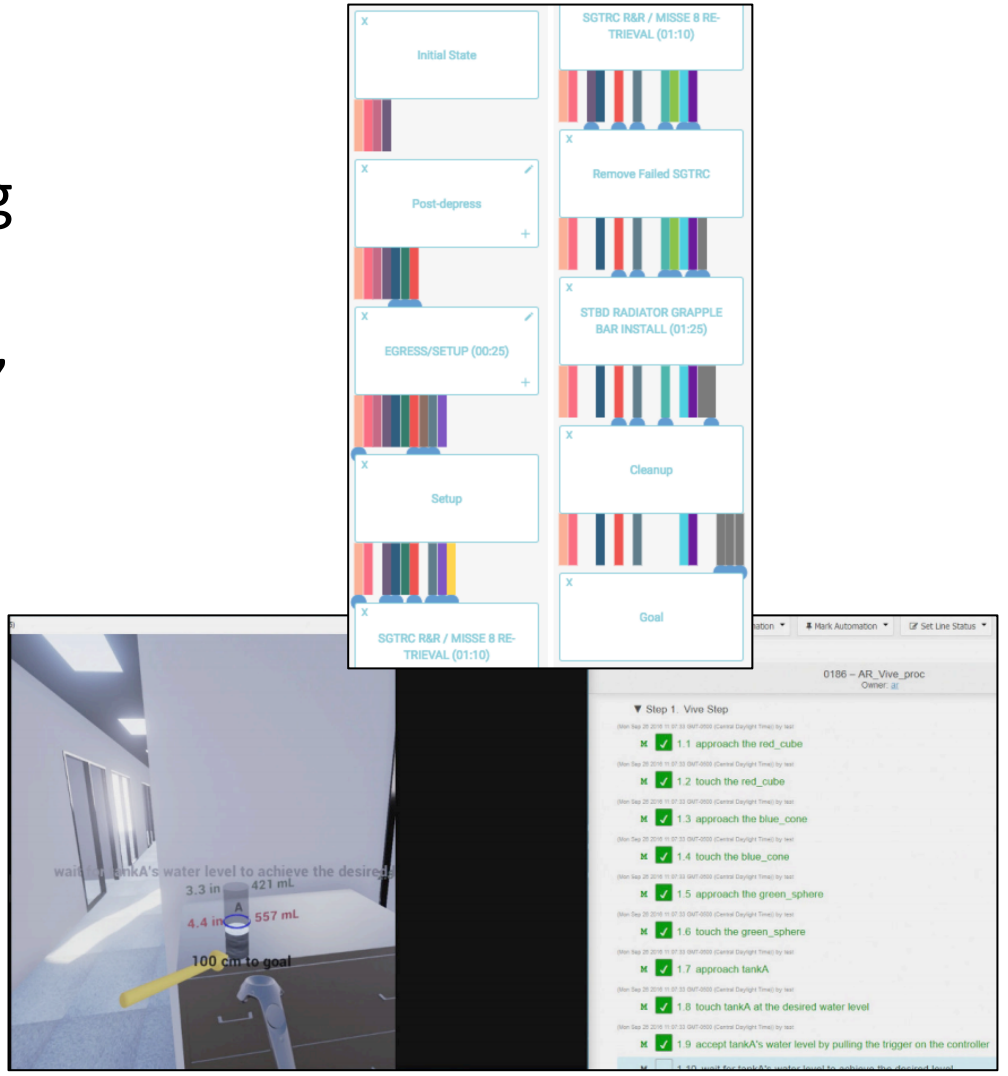
Papers

- RADAR
  - Plan authoring tool
  - Provides mixed initiative planning and visualization for different amounts of human-planner interaction
- WEB-PLANNER
  - Plan domain modeling and visualization tool
  - Provides plan domain, model, and search space visualization



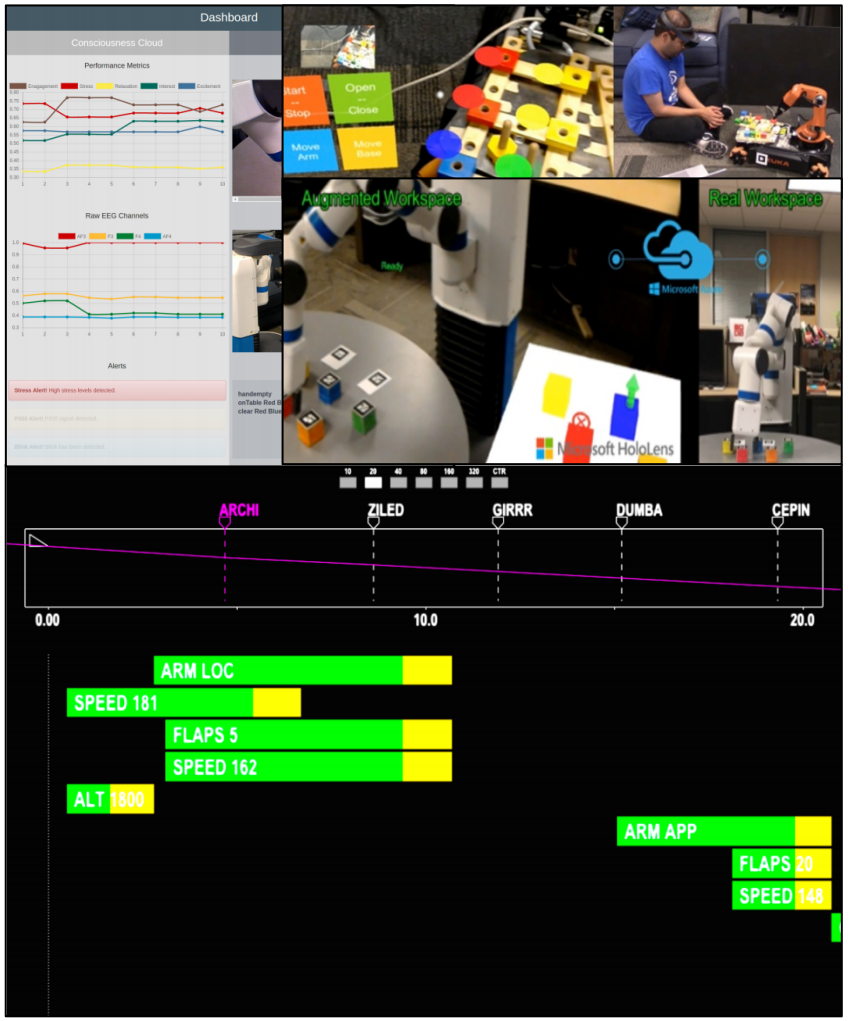
Papers

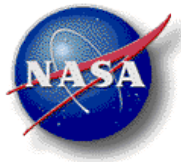
- Conductor
  - Plan domain modeling and visualization tool
  - Provides plan domain, model, and search space visualization
- PRIDE-AVR
  - Procedure authoring tool
  - Able to author procedures including graphics and VR/AR content



Papers

- Æffective Robotics
  - Augmented reality-based plan execution and replanning using EEG
  - Demonstrated for mixed human-robot teams
- CHAP-E
  - Provide aircraft pilot real-time planning, decision support, and plan executio situational awareness



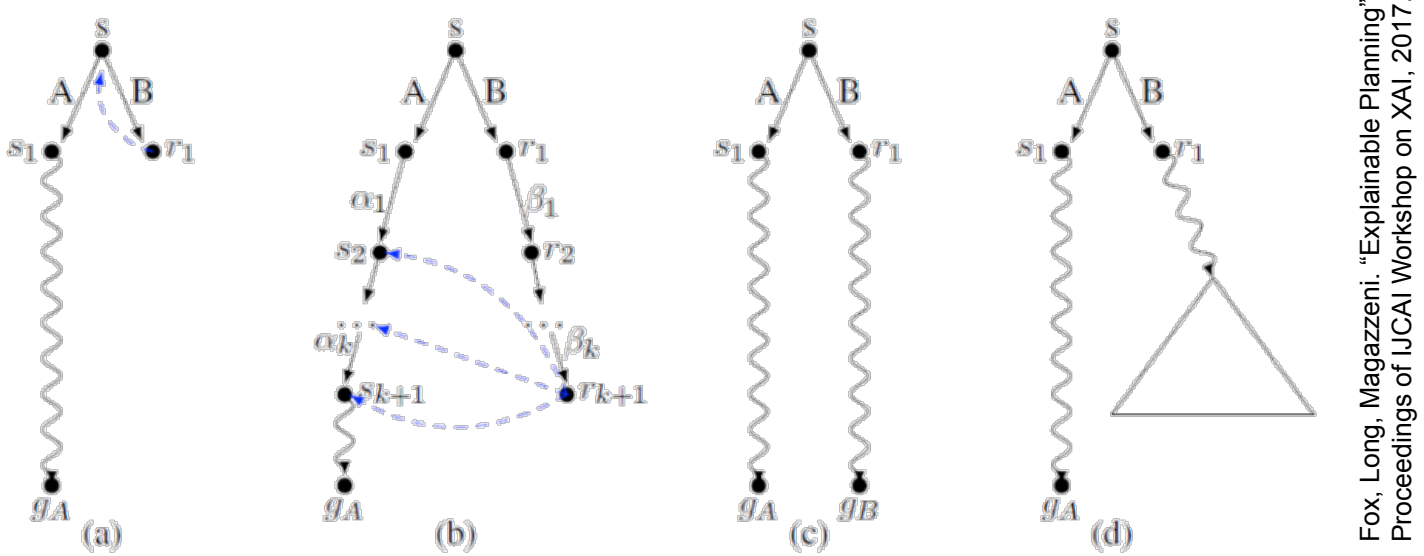


Papers

- CRADLE
  - Plan recognition tool
  - Workload reduction for analysts
  - Demonstrated on financial services application
- Complexity Metrics
  - Discussion of multi-agent / collaborative team plan complexity metrics
  - Discussion of how to integrate these metrics into plan synthesis

Invited Talks

- User Interfaces for Explainable Planning (XAIP)
  - More than just ***describe*** the plan; ***justify*** planning decisions, ***explain*** search choice and logic, ***explore*** alternate plans

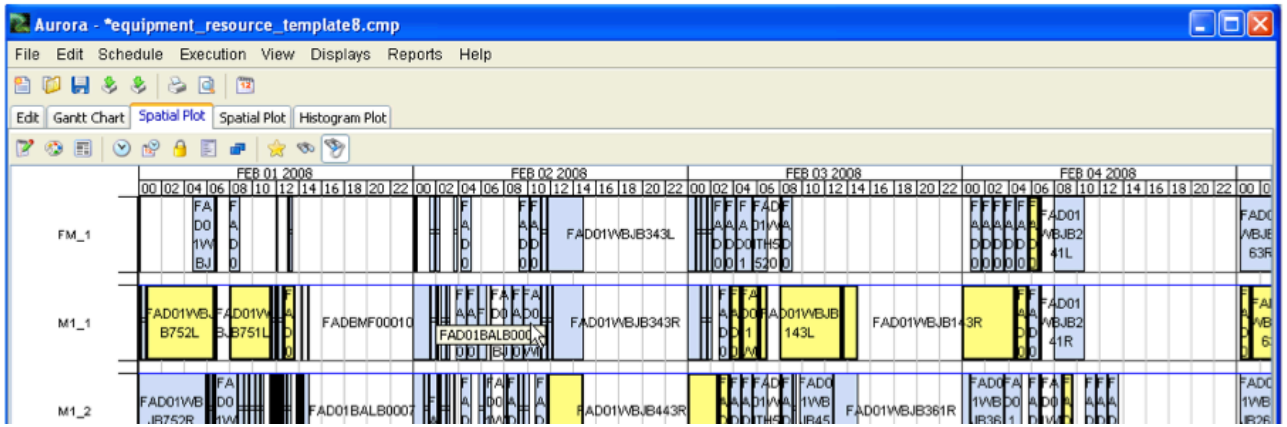


Fox, Long, Magazzeni. "Explainable Planning". Proceedings of IJCAI Workshop on XAI, 2017.

  - Allow the user to accept/reject only part of a (rather than whole) plan
  - Allow the user to add new (high-priority) goals and modify the planning model at execution time

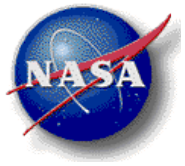
Invited Talks

- Want to Field Your PS System? Suck it Up!
  - 'Refitting' APS to existing tools requires understanding customers' stake in current system



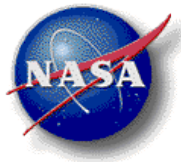
  - Limited existing UI features (can't display 'top-K' plans or explanations; can't redisplay plans easily,)
  - Customers' knowledge of plan generation process also constrains use of APS technology

Stottler. Screenshot from slides. Available on-line at: http://icaps17.icaps-conference.org/workshops/UISP/ICAPS2017-DOS.pdf



Panel: Discussion

- Community Focus
  - Academic work vs. Fielding applications
  - Research vs. Engineering
- Ideal team
  - APS researchers are not our own customer, nor should we pretend to be
  - APS researchers are not human factors people
- Engineering
  - Applications ***may not need*** bleeding edge research, but can benefit from our technology
  - Design iterations are key to success; exploit model-based paradigm



Panel: Challenges

- Public and industry perception that AI planning isn't useful…
  - How to market techniques better?
- Standardized plan output format for UIs?
- 'Canonical' set of UI modalities? Accompanying 'canonical' set of plan display software widgets?
- UI for APS competition?
  (A blend of IPC and KEPS competition?)

Engaging Other Communities!

- Recently concluded VAM-HRI 2018
  (first ever workshop on virtual, augmented and mixed-reality for human-robot interaction)
  - *featured work at the intersection of UISP and HRI*
- Please consider attending the 2018 UISP Workshop!
  - http://icaps18.icaps-conference.org/uisp/
- Please consider attending the 2018 XAIP Workshop!
  - http://icaps18.icaps-conference.org/xaip/
- Please consider helping organize and run a workshop in 2019!
  - Right around the corner!

Some Videos: UISP and others!

NASA Exploration Ground Data System (long)

- https://www.youtube.com/watch?v=CrDdtVEJyCk

Orion Cockpit (short)

- https://www.youtube.com/watch?v=cM4qKfNuFX4

PRIDE

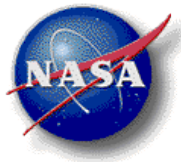
https://traclabs.com/projects/alternate-realities/

RADAR

- https://www.youtube.com/watch?v=x5lYDnSh3B8

ÆRobotics

- https://www.youtube.com/watch?v=5EJPc8YaIuE



Thank You!

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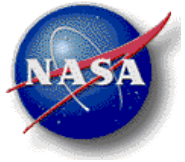
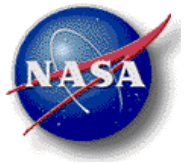


Ancient History (>10 years)

- Spoken language interfaces to AI planning
  - Dowding et al. 2002
  - DARPA CALO project (origins of Siri) (2005)
- Integrating automated reasoning and humans
  - Maldague et al. 1997, Myers et al. 1999, 2000, Klau et al. 2002, Anderson et al. 2000
- Automated reasoning to build UIs
  - Weld et al. 2003, Gajos et al. 2004
- …and much more!

Not-So-Ancient History (within 10 years)

- Aerospace (ahem, NASA) Applications
  - Bresina et al. 2005, Aghveli et al., 2007, Deans et al. 2011, Meuleau et al.,2009, Frank et al. 2017
- Integrating automated reasoning and humans
  - Mohseni-Kabir 2015
- Planning visual search strategies for improved UIs
  - Chen et al. CHI 2015
- Human Robot Interaction
  - Nikolaidis et al., 2012, Lasota et al., 2015, Gombolay et al., 2017
- Knowledge Engineering Tools
  - Vaquero et al., 2007
- …and much more!



Related Works on APS and UIs

APGEN: A Multi-Mission Semi-Automated Planning Tool. Pierre F. Maldague, Aidans Y.Ko, Dennis N. Page, Thomas W. Starbird. IWPSS 1997

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D. Weld, C. Anderson, P. Domingos, O. Etzioni, T. Lau, K. Gajos, and S. Wolfman, "Automatically Personalizing User Interfaces" IJCAI-03, August 2003.

K. Gajos and D. Weld, "SUPPLE: Automatically Generating User Interfaces" IUI-04, 2004.

John L. Bresina, Ari K. Jónsson, Paul H. Morris, and Kanna Rajan. Activity Planning for the Mars Exploration Rovers". ICAPS 2005

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Planning Applications for Three Mars Missions with Ensemble. Arash Aghevli, Andrew Bachmann, John Bresina, Kevin Greene, Bob Kanefsky, James Kurien, Michael McCurdy, Paul Morris, Guy Pyrzak, Christian Ratterman, Alonso Vera, Steven Wragg. IWPSS, 2007

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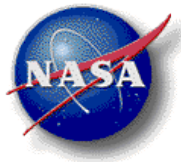

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