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# In Closing

## Some KRR Applications

# Objectives

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## Objective

Identify some applications of KRR and find applications of your own interests



# QA System for Hypothetical Questions

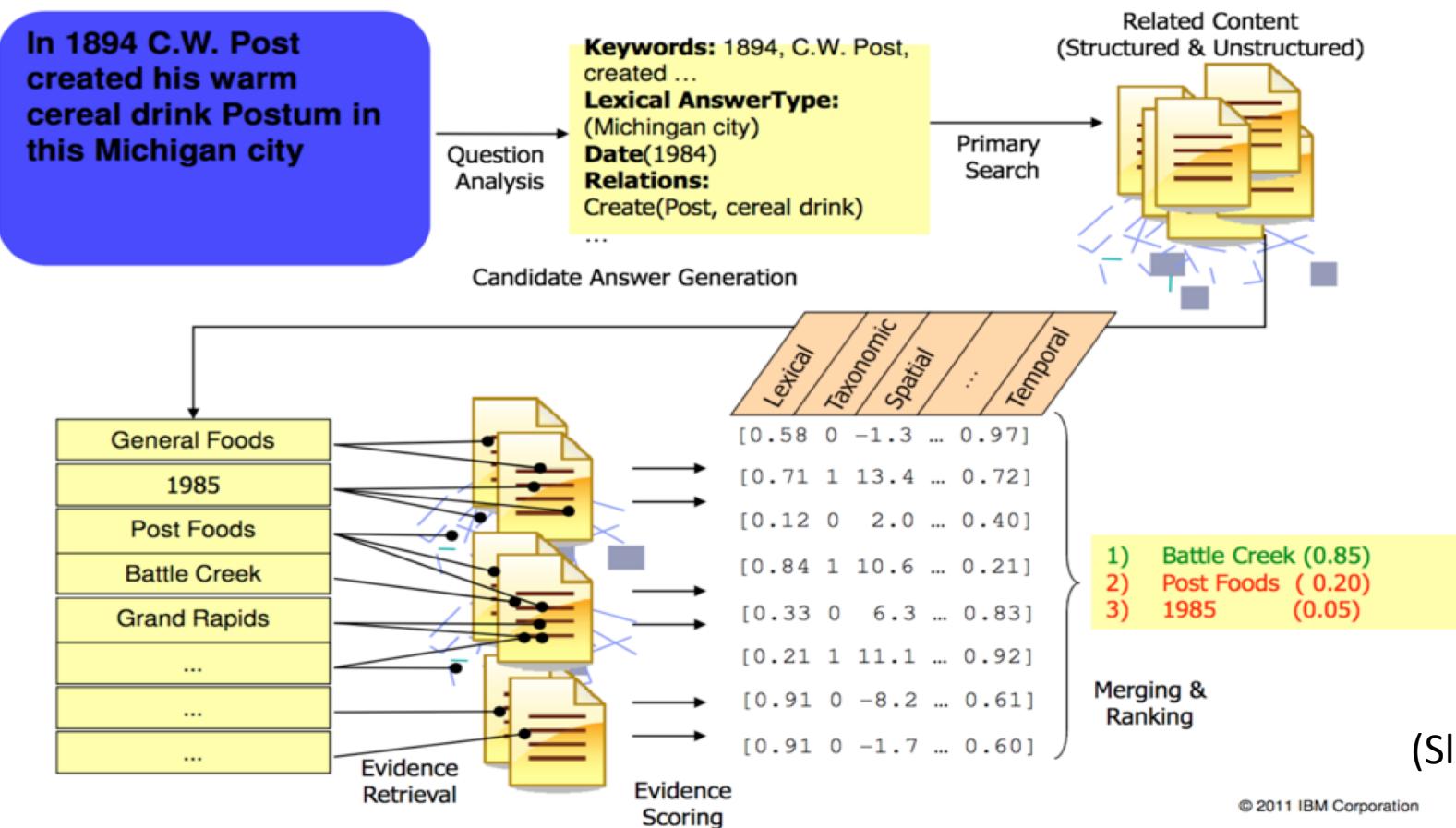
(Wang, Lee, and Kim, “A Logic Based Approach to Answering Questions about Alternatives in DIY Domains”, 2017)

# QA System (for Factoid Questions)



Watson: associative learning  
Good for factoid questions

## Example Question



(Slides borrowed from James Fan)

# QA System for Hypothetical Questions



- Questions such as “what if”, “can I do ... instead ...”?
- QA System for DIY (Do It Yourself)
- Professionals who can answer questions are usually unavailable
- Many of the questions cannot be answered by simple database/knowledge base search, requires context-awareness (DIY project, user’s skill level, time constraints, etc.), as well as ability to explain

# Example

## Armchair with stool

No pain no gain  
**Armchair w**

You won't find a better sitting in this self-made you'll have to build it first



Watch video

Required power tools:

	Easy	Universal	Expert
> Jigsaw	✓	✓	✓
> Cordless universal			
> Multi-sander			
> Cordless drill/driver			
> Cordless screwdriver			
> Bench drill			
> Hand-held circular saw			
> Cordless tacker	✓		
> Router	✓	✓	✓
> Fine spray system	✓	✓	✓

Can I use table saw instead of jigsaw?

# Using Google

jigsaw vs table saw 

All Shopping Videos Images News More Settings Tools

About 531,000 results (0.83 seconds)

Reciprocating **saws** are for not delicate work and cut fast, the blades bend if you let the tip of the blade bounce on your work. Circular **saws** are for relatively straight cuts, their blades do not break or bend, readily. Miter **saws** are for nice, straight cut-offs. ... A **jig saw** is for cutting curves, a circular **saw** is not. Oct 16, 2014

**tools - Should my first power saw be a circular or jig saw? - Home ...**  
[diy.stackexchange.com/questions/.../should-my-first-power-saw-be-a-circular-or-jig-saw](http://diy.stackexchange.com/questions/.../should-my-first-power-saw-be-a-circular-or-jig-saw)

About this result • Feedback

**Woodworking How to Use 4 Basic Saws - Instructables**  
[www.instructables.com/id/Woodworking-How-To-Use-4-Basic-Saws/](http://www.instructables.com/id/Woodworking-How-To-Use-4-Basic-Saws/)

The four saws: 1) The **table saw** 2) The circular saw. 3) The ... When it comes to versatility among saws, nothing can beat the **jigsaw** and for good reasons, too.

**Jigsaw or Circular Saw – Which Should a DIYer Buy First? - ToolGuyd**  
[toolguyd.com › Power Tools › Saws](http://toolguyd.com/power-tools/saws)

Sep 10, 2015 - Without room for a **table saw**, and tired of working with frustrating edge ... So that's my take on the **jig saw** vs. circular saw purchasing decision.

**tools - Should my first power saw be a circular or jig saw? - Home ...**  
[diy.stackexchange.com/questions/.../should-my-first-power-saw-be-a-circular-or-jig-s...](http://diy.stackexchange.com/questions/.../should-my-first-power-saw-be-a-circular-or-jig-s...)

Oct 16, 2014 - Reciprocating **saws** are for not delicate work and cut fast, the blades bend if you let the tip of the blade bounce on your work. Circular **saws** are for relatively straight cuts, their blades do not break or bend, readily. Miter **saws** are for nice, straight cut-offs. ... A **jig saw** is for cutting curves, a circular **saw** is not.

**Jigsaw vs. Circular Saw – Get The Right Tool For The Job**  
[www.thesawguy.com › Circular Saws](http://www.thesawguy.com/circular-saws)

Search

Jigsaws and circular **saws** are both useful, but for different reasons. If you're not sure which one to buy or how to use it - we've got you covered:

## Band Saw vs Table Saw – Which Comes First? | - Toolerant

[www.toolerant.com/band-saw-vs-table-saw-which-comes-first/](http://www.toolerant.com/band-saw-vs-table-saw-which-comes-first/)

Apr 7, 2013 - Working with a hand-held **jigsaw** or circular saw can satisfy your basic needs, but .... A band saw is loud, but a **table saw** is much louder.

## table saw or jigsaw - Woodworking Talk - Woodworkers Forum

[www.woodworkingtalk.com/f12/table-saw-jigsaw-5045/](http://www.woodworkingtalk.com/f12/table-saw-jigsaw-5045/)

Jul 10, 2008 - I have been looking for a **table saw** but really cant afford one. The other option is a **jigsaw** maybe. Have thought of using a **jigsaw** and then ...

## If You Can Only Buy One Saw: Circular or Jigsaw? - The Garage ...

[www.garagejournal.com › ... › The Tools › General Tool Discussion](http://www.garagejournal.com/.../the-tools/general-tool-discussion)

Jan 16, 2013 - 20 posts - 17 authors

Building a small project like a train **table** well the **jig saw** will make all ... do not like cordless **saws** as I feel the cost **vs** performance **vs** battery life ...

## Bandsaw vs Jig Saw or Scroll Saw ??? - The Garage Journal Board

[www.garagejournal.com › ... › The Tools › General Tool Discussion](http://www.garagejournal.com/.../the-tools/general-tool-discussion)

Dec 4, 2012 - 9 posts - 8 authors

**Jig saw** can be used on wood, plastic, metal, depending on blade. ... be used to resaw thicker pieces of wood much safer than on a **table saw**.

## Life Without A Tablesaw? - The Wood Whisperer

[www.thewoodwhisperer.com/articles/life-without-a-tablesaw/](http://www.thewoodwhisperer.com/articles/life-without-a-tablesaw/)

Mar 17, 2012 - Whether you use a miter gauge or a cross-cut sled, the **tablesaw** is incredibly ... If you don't mind a rougher cut, you could also use a **jigsaw**. ..... My biggest concern; like Marc's is over kickback **vs** a cut, and as such I have ...

## Best Power Saw for a DIY Beginner? | Apartment Therapy

[www.apartmenttherapy.com/best-power-saw-111072](http://www.apartmenttherapy.com/best-power-saw-111072)

Mar 11, 2010 - I want something that's easy to use and versatile. Is there such thing as an "all- purpose power **saw**"? Should I buy a circular **saw** or a **jigsaw**?

# System Architecture

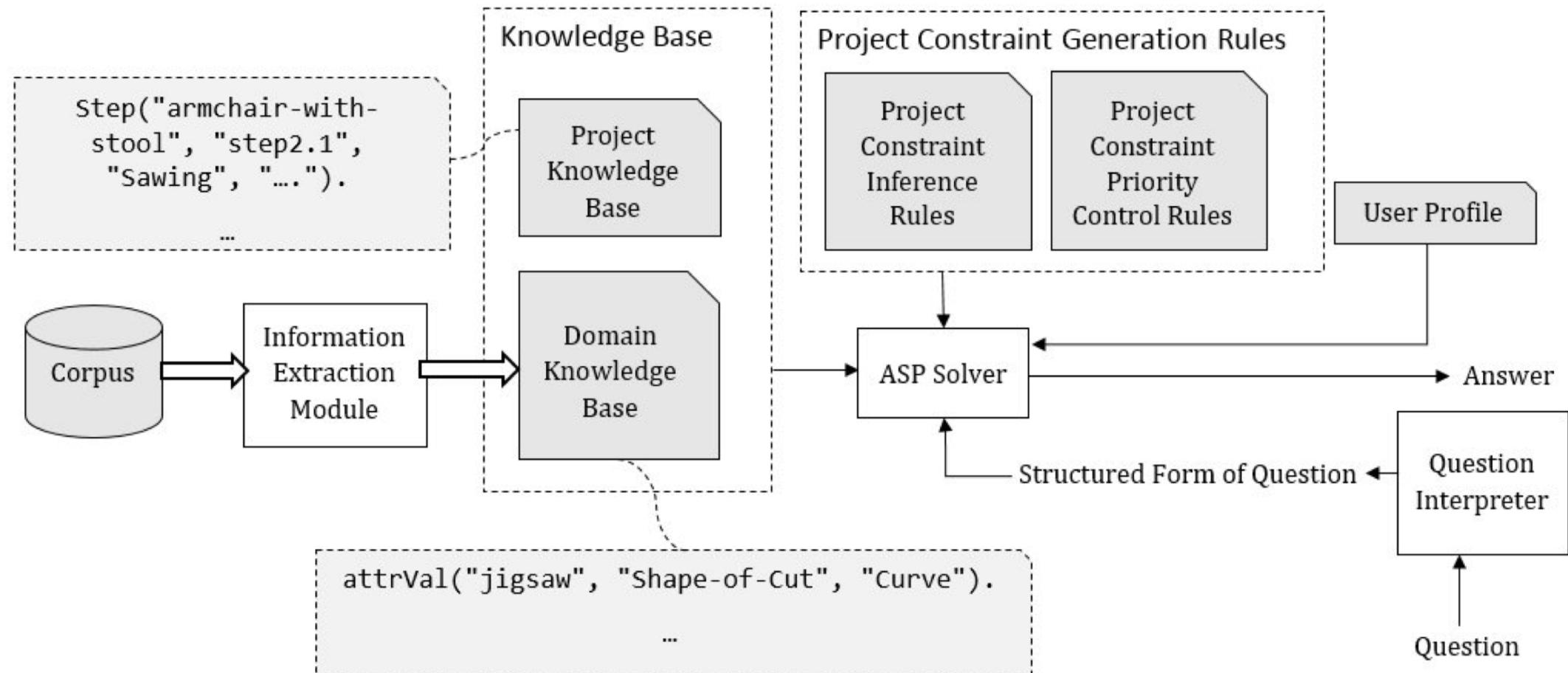


Figure 1: System Overview

# Can I use table saw instead of jigsaw? (System Output)



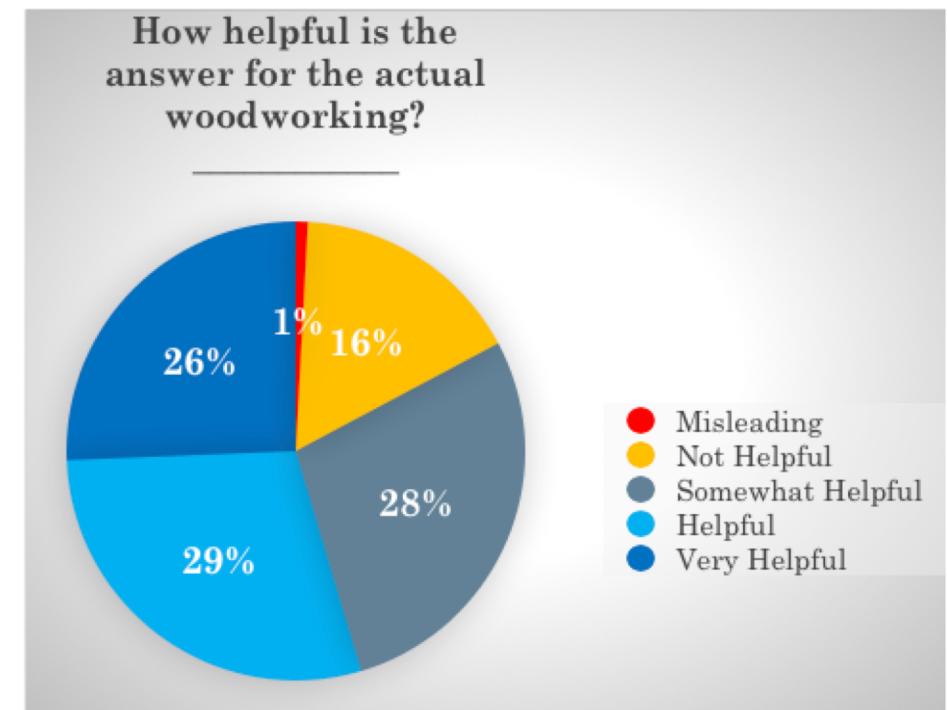
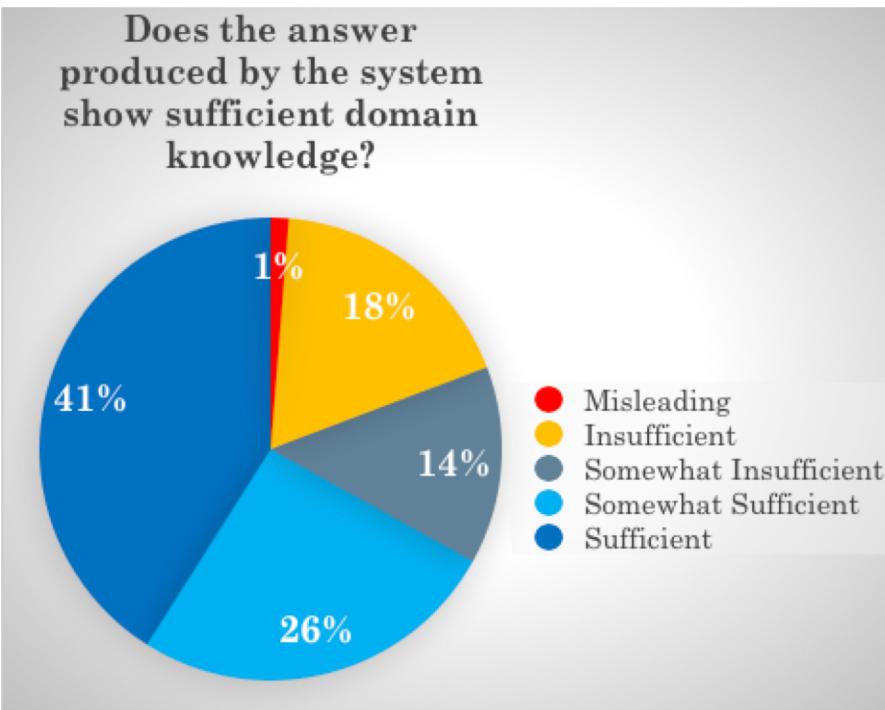
- Project:bird house for balcony and garden (where jigsaw is used cut straight lines)  
Possible. Please be aware of the following differences between the two entities:  
jigsaw:"Shape:Curve" "Shape:Circle"  
"Portability:Portable/Stationary"  
table-saw:"Shape:Ripcut" "Shape:Bevel-Cut"  
"Shape:Miter-Cut" "Portability:Stationary"
- Project:armchair with stool (where jigsaw is used cut curves)  
Not Recommended. table-saw does not support  
"Shape:Curve".

# Evaluation

| 250 amateur DIYers from Amazon Mechanical Turk were asked to answer our survey

| Using Google, 40% of the participants failed to find an answer within three minutes and that the average number of the websites visited by the participants was three.

| The system instantly provided answers with explanation; better user experience





# Reasoning about Access Control Policy

(Ahn, Hu, Lee, and Meng, “Representing and Reasoning about Web Access Control Policies,” 2010)

# Policy-Based Computing



- ▶ Policies are declarative specifications about the desired behaviors of a complex adaptive system.
  - ▶ Widely used in network and system management, privacy and security, business rules, . . .
- ▶ Policy-based computing helps to handle complex system properties by separating policies from system implementation.
- ▶ The increasing complexity of policy-based computing demands strong support of automated reasoning techniques.

# Access Control Policies



- ▶ An access control policy is about authorizing a group of users to perform a set of actions on a set of resources.
- ▶ XACML (eXtensible Access Control Markup Language):
  - ▶ An XML-based access control policy description language.
  - ▶ Widely adopted standard to specify access control policies for various web applications.
  - ▶ Well supported by Organization for the Advancement of Structured Information Standards (OASIS) whose members include IBM, Microsoft and ORACLE.

# Reasoning about XACML Description



| Semantics of XACML is semi-formal

| Automated analysis services?

- Assuring correctness
- Identifying inconsistencies/conflicts
- Policy comparison
- Checking redundancies
- ....

# Example Access Control Policy



- ▶ The global policy of the entire company:
  - ▶ employees can read and change codes during working hours (8:00 - 17:00), and
  - ▶ nobody can change codes during non-working hours.
- ▶ The local policy of a development department:
  - ▶ developers can read codes during non-working hours,
  - ▶ testers cannot read codes during non-working hours, and
  - ▶ testers and developers cannot change codes during non-working hours.

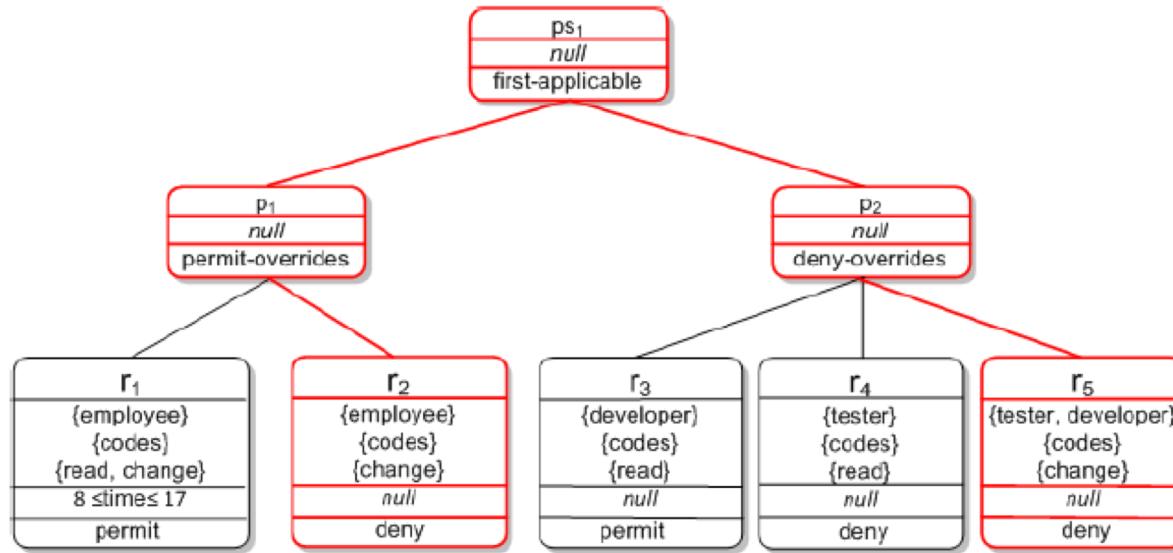
The global policy supersedes the local policy.

# Example XACML Code

```
<PolicySet PolicySetId="ps1" PolicyCombiningAlgId="first-applicable">
  <Target/>
  <Policy PolicyId="p1" RuleCombiningAlgId="permit-overrides">
    <Target/>
    <Rule RuleId="r1" Effect="permit">
      <Target>
        <Subjects><Subject> employee </Subject></Subjects>
        <Resources><Resource> codes </Resource></Resources>
        <Actions><Action> read </Action>
                  <Action> change </Action></Actions>
      </Target>
      <Condition> 8 ≤ time ≤ 17 </Condition>
    </Rule>
    <Rule RuleId="r2" Effect="deny">
      <Target>
        <Subjects><Subject> employee </Subject></Subjects>
        <Resources><Resource> codes </Resource></Resources>
        <Actions><Action> change </Action></Actions>
      </Target>
    </Rule>
  </Policy>
```

# Policy Analysis

Is the request by the developer to read the code during non-working hours always permitted?



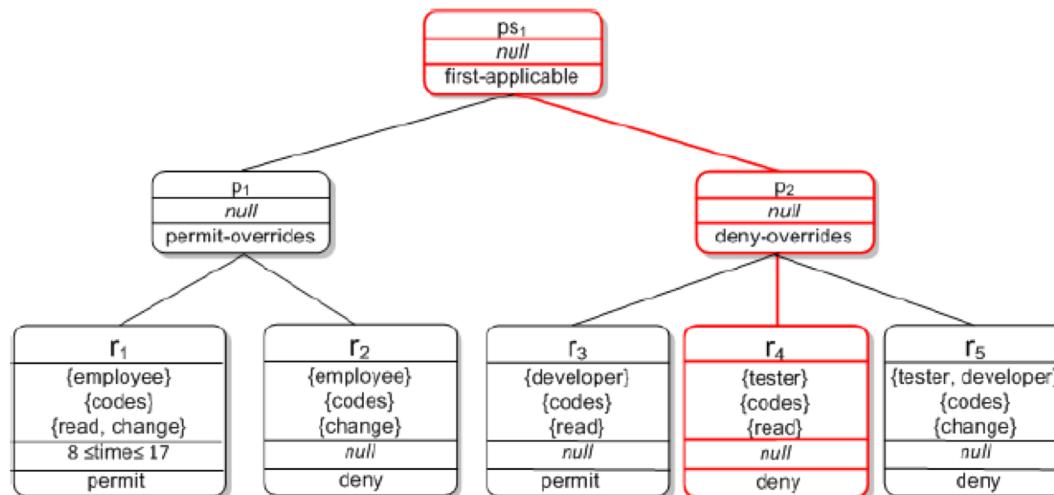
A: No, if the request also contains changing the codes:

*Answer Set : {subject(developer) subject(employee)  
action(read) action(change) resource(codes) ...}.*

# Policy Analysis

| Okay, let's say no two requests at the same time.

| Same question: Is the request by the developer to read the code during non-working hours always permitted?



A: Still no, if the developer is also a tester:

*Answer Set : {subject(*developer*) subject(*tester*)  
subject(*employee*) action(*read*) resource(*codes*) ...}.*



# Inferring Phylogenetic Trees

(Brooks, Erdem, Erdogan, Minett, Ringe, “Inferring phylogenetic trees using answer set programming” (2007)

# Phylogenetic Trees



- | A phylogenetic tree or evolutionary tree is a branching diagram or "tree" showing the evolutionary relationships among various biological species or other entities
- | Phylogenetic trees of individual languages help historical linguists to infer principles of language change; and
- | are also of interest to archaeologists, human geneticists, physical anthropologists (e.g., evolutionary history of certain languages can help us answer questions about human migrations)

# Inferring Phylogenetic Trees



| After describing each taxonomic unit with a set of characters, and determining the character states...

English	German	French	Spanish	Italian	Russian
<i>hand</i>	<i>Hand</i>	<i>main</i>	<i>mano</i>	<i>mano</i>	<i>ruká</i>
1	1	2	2	2	3

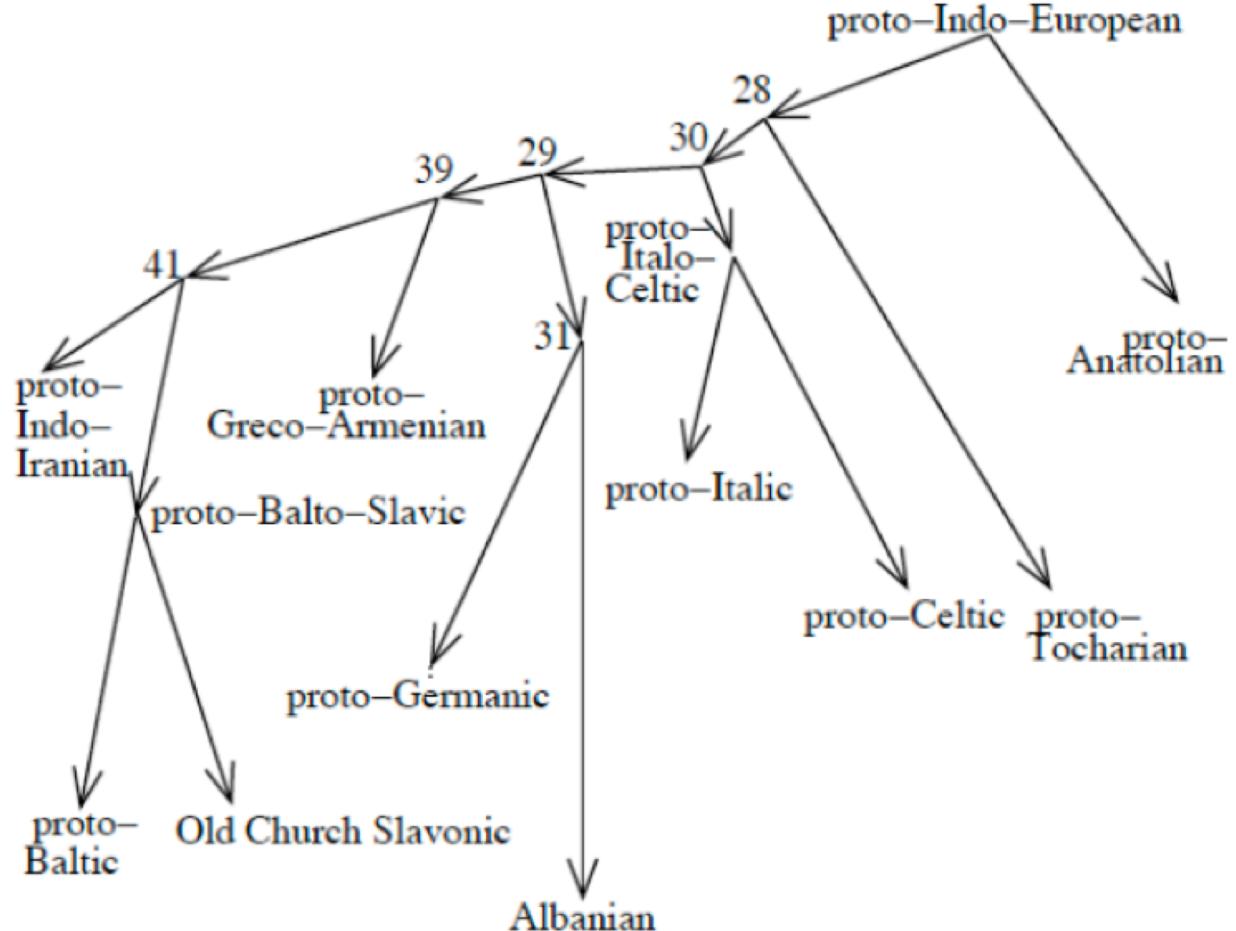
| The goal is to reconstruct a phylogeny with the maximum number of “compatible” characters

| Challenges: reachability checks, aggregates, constraints, weights, etc.

# Phylo-ASP

- | ASP-based phylogenetic system
- | that not only infers (weighted) phylogenetic trees but also helps the experts analyze and compare them (e.g., by generating similar/diverse phylogenetic trees).

(Phylogeny for Indo-European Languages generated by Phylo-ASP)



# Wire Routing

(Erdem, Lifschitz, and Wrong, “Wire routing and satisfiability planning”, 2000)

# Wire Routing

Determine the physical locations of all wires interconnecting the circuit components on a chip.

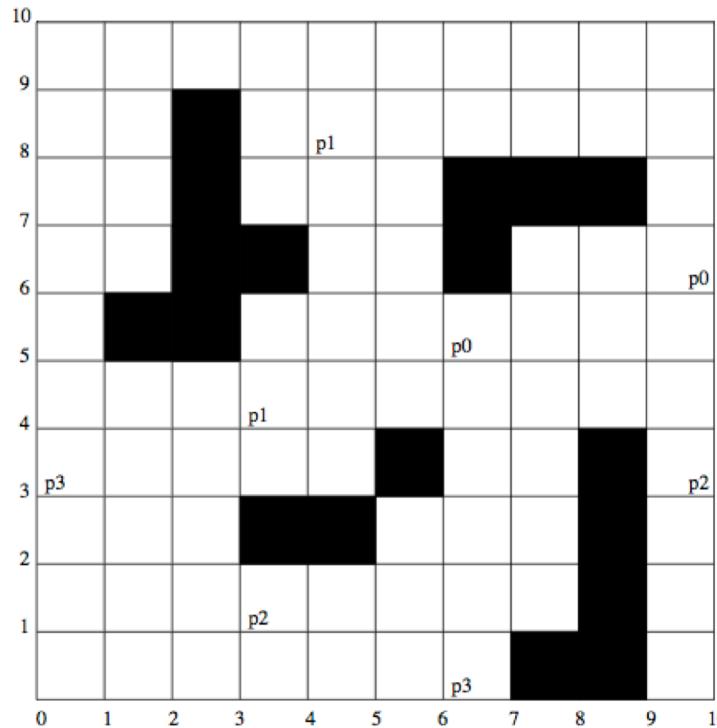


Fig. 1. A routing problem with 4 wires.

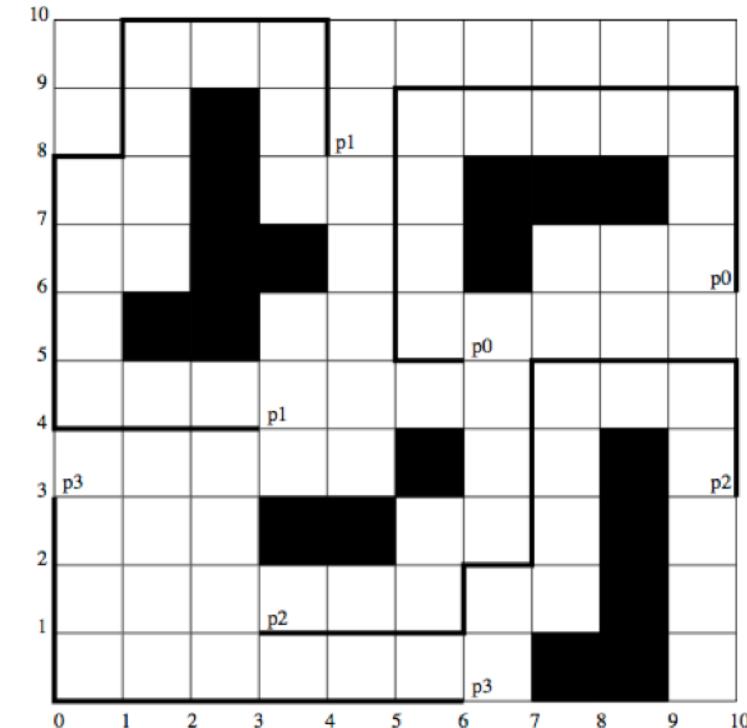
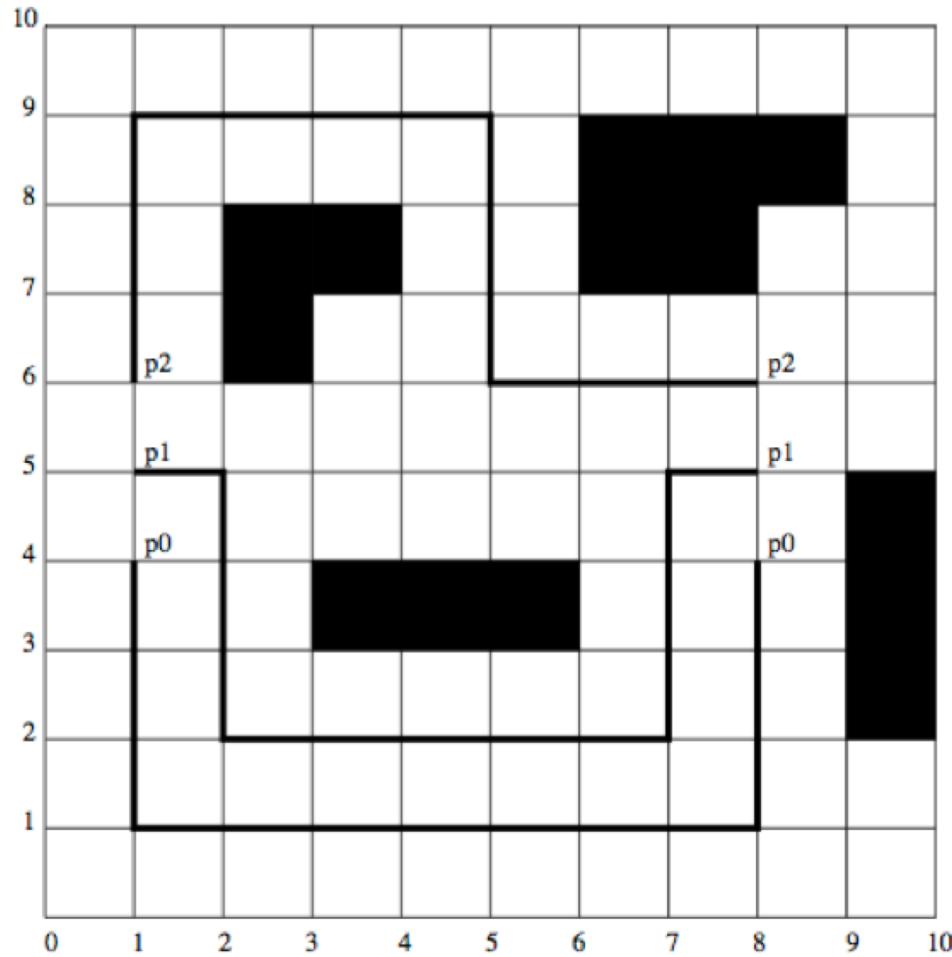
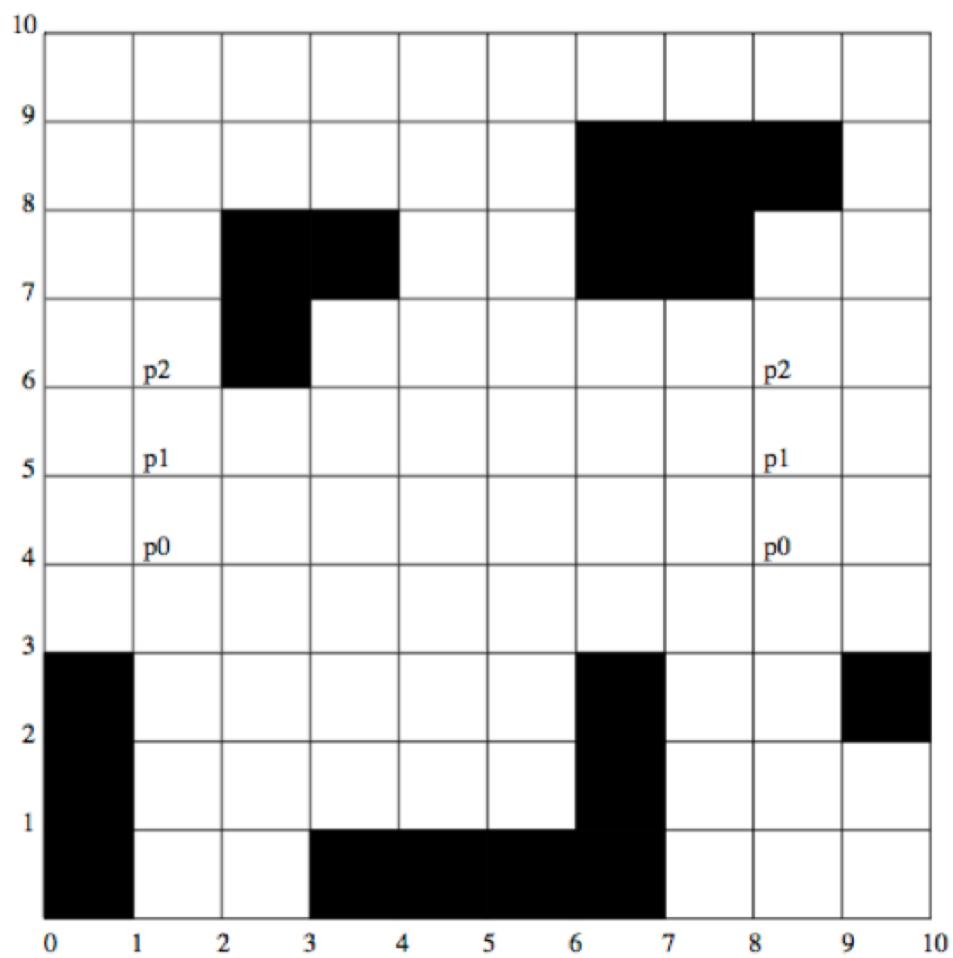


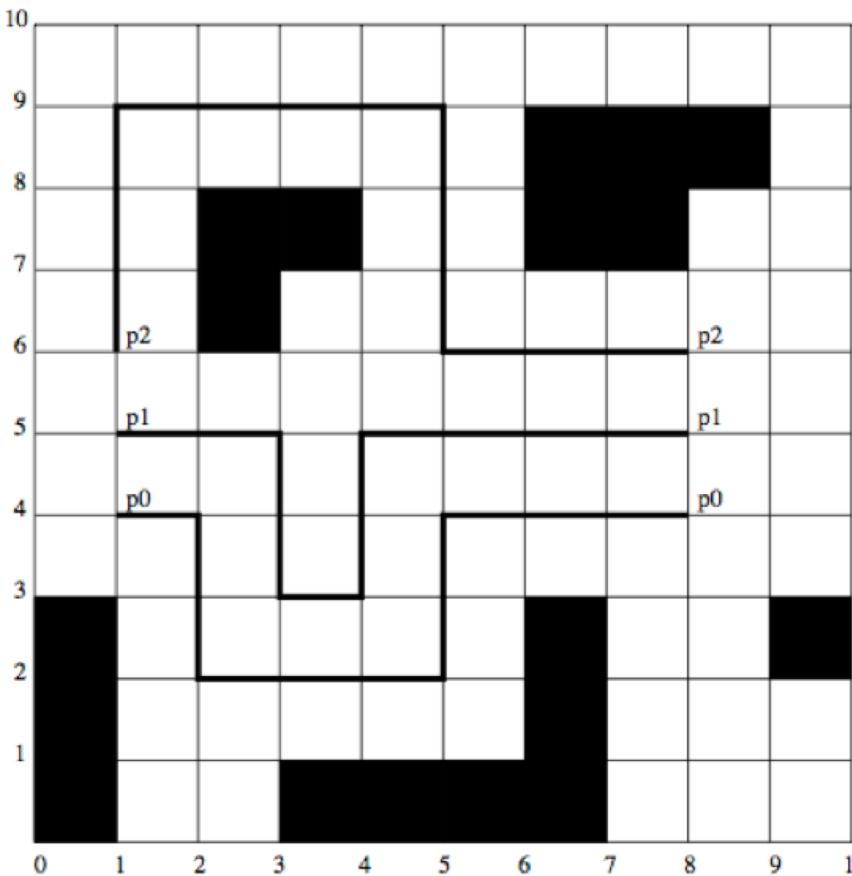
Fig. 2. A solution to the problem from Fig. 1.



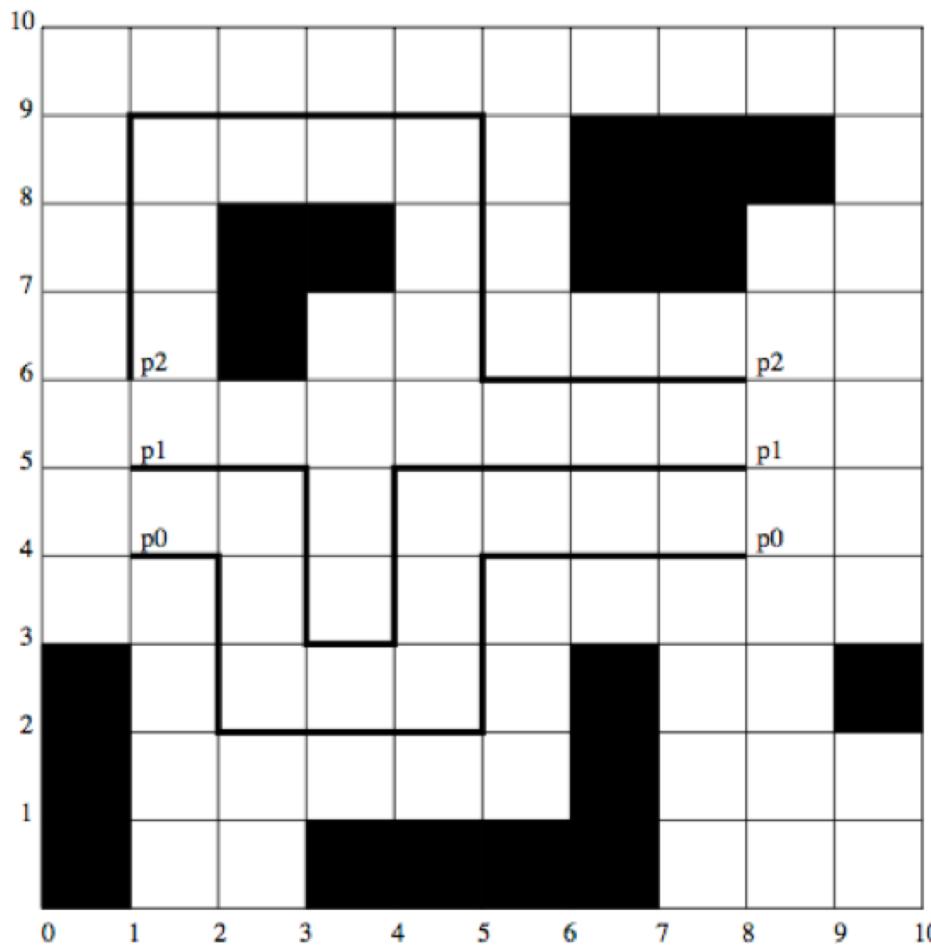
**Fig. 5.** A bus routing problem. The wires are required to have the same length.



**Fig. 7.** A bus routing problem that has no precise solution.



**Fig. 8.** An approximate solution to the problem from Fig. 7. The differences between the lengths of wires are limited by 2.



**Fig. 8.** An approximate solution to the problem from Fig. 7. The differences between the lengths of wires are limited by 2.



# Other Applications

# Cognitive Robotics



| ASP was applied for planning of actions of multiple robots to collaboratively tidy up a house within a given time (Erdem, Aker, and Patoglu, “Answer Set Programming for Collaborative Housekeeping Robotics,” 2012)

| ASP was used to find an optimal global plan for multiple teams of heterogeneous robots in a cognitive factory to manufacture a given number of orders within a given time (Erdem et al., Finding Optimal Plans for Multiple Teams of Robots Through a Mediator,” 2013)

# E-Tourism



- | ASP-based intelligence advisor that selects the most promising offers for customers of a travel agency
- | Helps the employees of a travel agency in finding the best possible travel solution in a short time.
- | A set of tour packages and their pre-booked quantities are selected such that costs are minimized
- | Employed by the tour operator Top Class s.r.l.

# Configuration



- | Configuration of Linux package (Gebser, Kaminski, and Schaub, “aspcud: a linux package configuration tool based on answer set programming”, 2011)
- | Siemens applied ASP to automatically configure parts of a railway safety system (Aschinger et al., “Optimization methods for the Partner Units problem,” 2011)
- | ASP was applied within a portfolio solver which solves the station repacking problem of reallocating the frequency bands of television broadcasters (Fréchette, Newman, Leyton-Brown, “Solving the station repacking problem,” 2016)

# Other Industrial ASP Applications



- | Decision support systems (Nogueira et al., 2001)  
used by Space Alliance
- | Automated product configuration (Tiihonen,  
Soininen, and Sulonen, 2003) used by Variantum  
Oy
- | Intelligent call routing (Leone and Ricca, 2015)  
used by Italia Telecom

# References

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- | Erdem, Gelfond, and Leone, “Applications of Answer Set Programming,” 2016
- | Falkner, Friedrich, Schekotihin, Taupe, and Teppan, “Industrial Applications of Answer Set Programming,” 2018

# Wrap-Up

