

eSTAR

Agent architectures

Smarter software for astronomers

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What is an agent?

- An agent is “just software” not magic

Loosely, an agent is a computational entity which:

- Acts on behalf of another entity in an autonomous fashion
- Performs its actions with some level of proactivity and/or responsiveness
- Exhibits some level of the key attributes of learning, co-operation and mobility

Agents as architecture

- From a developer's perspective there are five major trends which are evident from the history of computing. These are,
 - *ubiquity*
 - *interconnection*
 - *intelligence*
 - *delegation*
 - *human-orientation*
- Agent architectures are the next paradigm shift following these trends.

The intelligence thing...

- The complexity of tasks that we are capable of automating and delegating to computers has grown steadily
- If you don't feel comfortable with this definition of "intelligence", it's probably because you're human

The delegation thing...

- Computers are doing more for us – without our intervention
- We are *giving control* to computers, even in safety critical tasks
- One example: fly-by-wire aircraft, where the machine's judgment may be trusted more than an experienced pilot

Multiagent systems

- A multiagent system is one that consists of a number of agents, which *interact* with one-another
- In the most general case, agents will be acting on behalf of users with different goals and motivations
- To successfully interact, they will require the ability to *cooperate*, *coordinate*, and *negotiate* with each other, much as people do

Barriers and Flatness

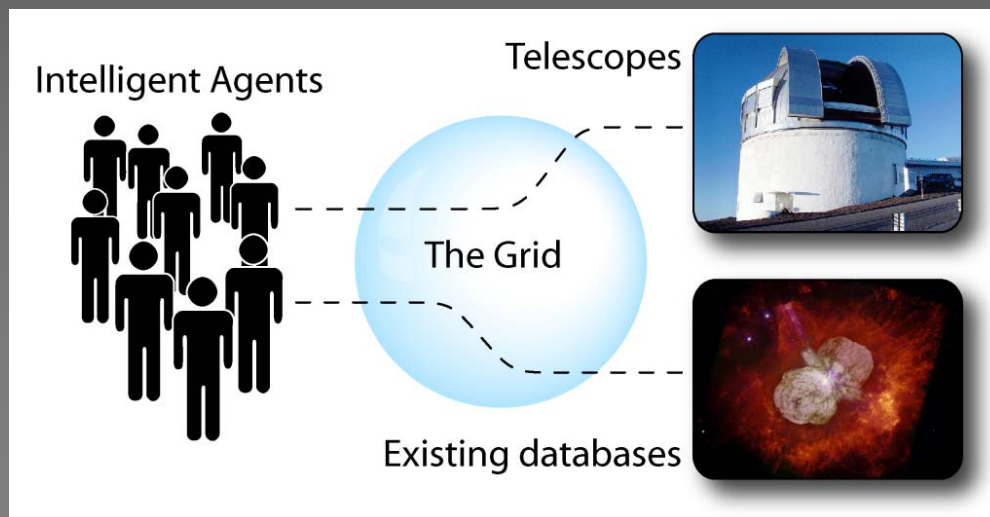
- If you put barriers in the way of people who want to do something, they will find ways around these barriers.
- The real world does not operate in a hierarchical manner.
- In the real world you usually know someone, who knows someone, who knows what you want.

Peer-to-Peer

- Agents operate in a peer-to-peer manner and can make use of these interconnections between people and data.
- Carrying out intelligent resource discovery could mean that your agent looks to your collaborators agent for data and expertise before it looks to “central” sources.

Multiagent systems for eSTAR

- The eSTAR uses the collaborative agent paradigm, with a flat peer-to-peer network topology.
- A hierarchical system would not be robust, or scale well, and it's not the way the real world operates.
- We've built the first agent based astronomical system, and it was clearly the correct choice of architecture.



We are not alone...

- NASA is using agent based systems to give their probes more autonomy — giving them richer decision making capabilities and responsibilities, e.g. Deep Space 1.
- The Michigan Digital Library is using agent based systems to data mine distributed heterogeneous datasets with complex interconnections.

The world is flat...



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The world is **small** and **flat**, but none the less, it is still **very complex**.

An architectures which takes account of this are intuitive, and will map well in the real world.

Multi-agent systems for the VO

Using agents means that we provide,

- abstraction
- collaboration
- intelligent resource discovery

Summary

- The world is small and flat but none the less still very complex
- Multiagent systems can use this to their advantage
- We therefore believe there are data mining problems that are best solved using this approach
- It would have been hard to build eSTAR without the agent paradigm.