Beyond Point Design: General Pattern to Specific Implementations

Joel Lachter
Summer L. Brandt
Garrett Sadler
R. Jay Shively

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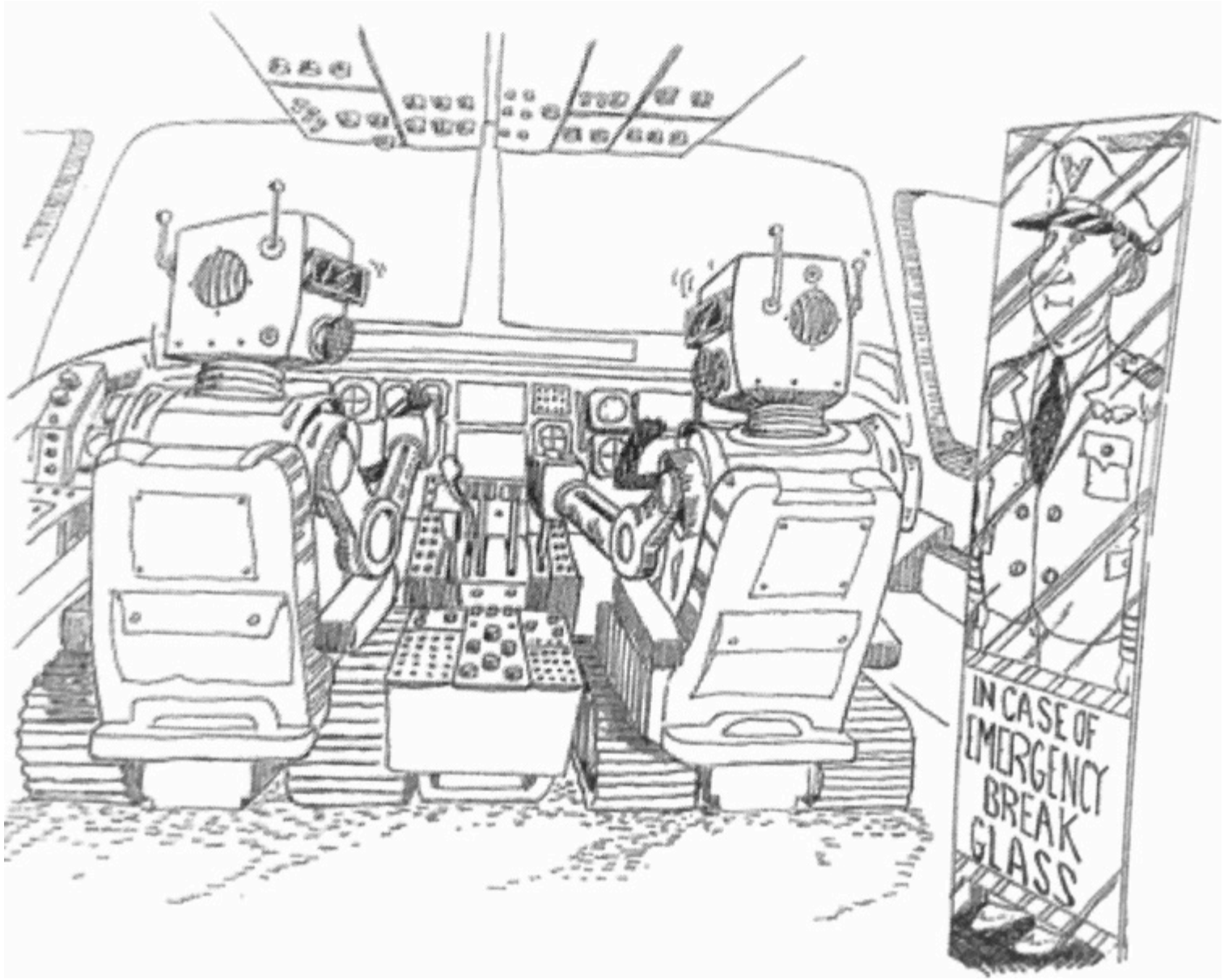
Talk Outline

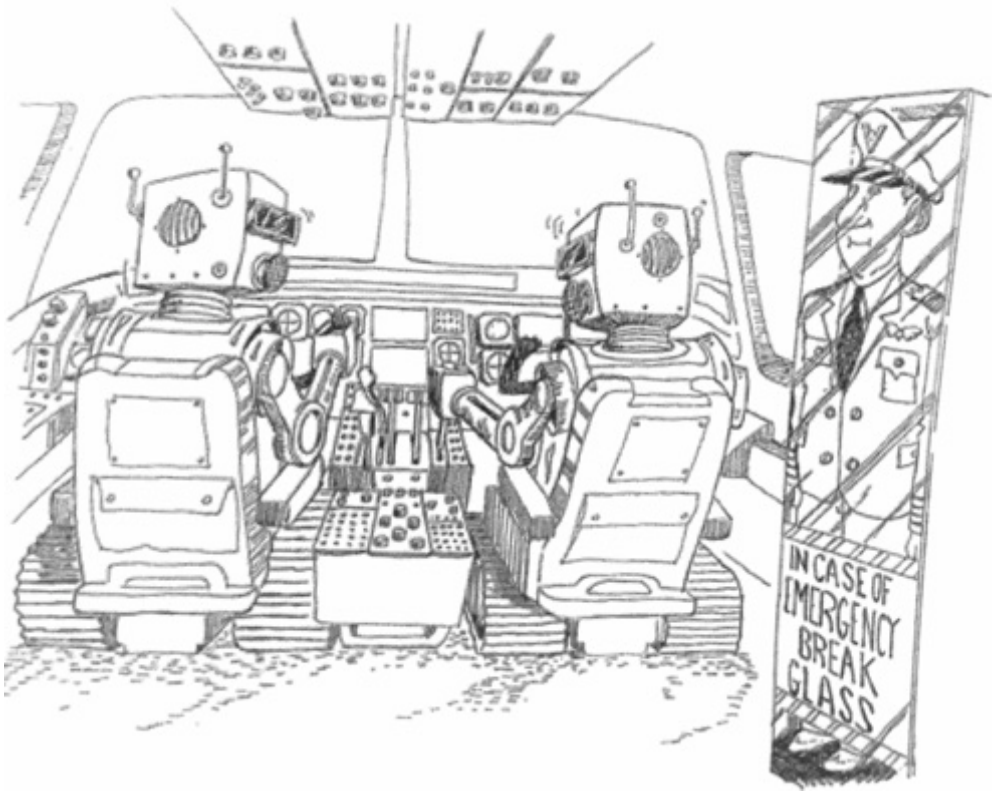
- Review of HAT Principles
- How implementing HAT could improve interaction with automation you use regularly:
  - Navigation
  - Photography
- Common themes for implementing HAT
- Design Patterns: Common Problem-Solution Pairs

Human-Machine Function Allocation



Problems

- Miscalibrated Trust
  - People don't know when to break the glass
- Brittle
  - You have to break the class
- Out-of-the-Loop Loss of Situation Awareness
  - When you brake the glass, the pilot has no idea what is going on
- Opaque
  - There is no easy way for the pilot to figure out what is going on



Alternative: Make the Automation a Teammate

Plays

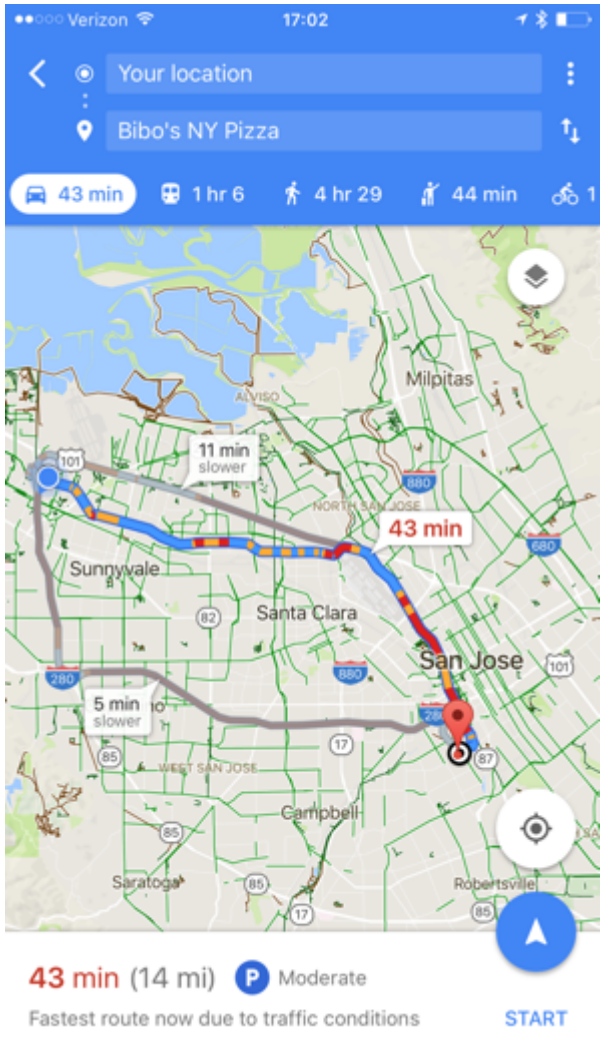
Standard Operating Procedures

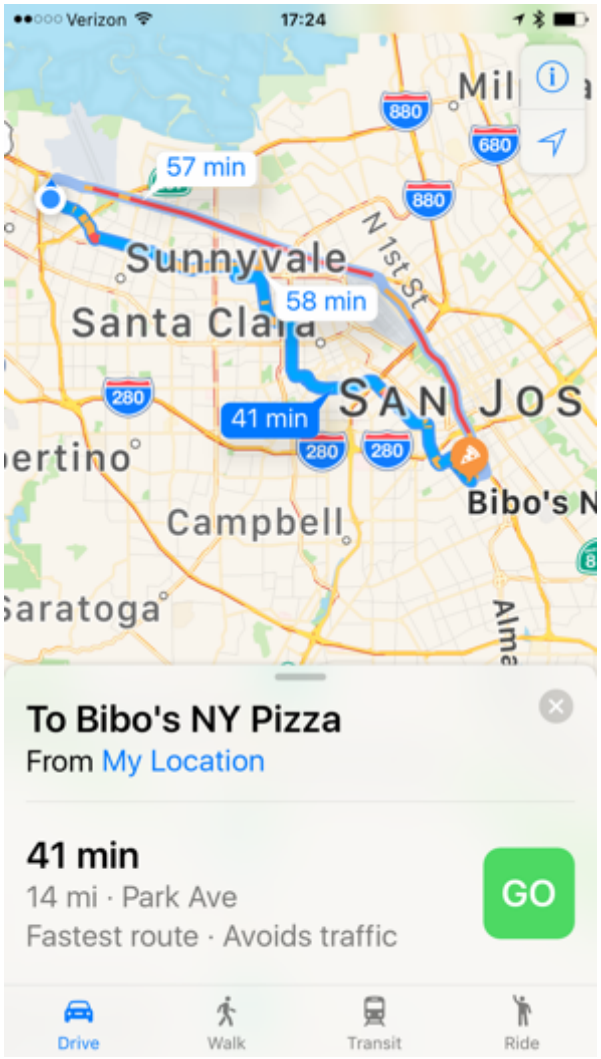
Transparency
Communication of Rationale
Communication of Confidence
Shared Language
Shared Goals
Shared Plans
Shared Info About Threats
Agreed Allocation of Responsibility
Real Time Delegation
Minimized Intent Inferencing

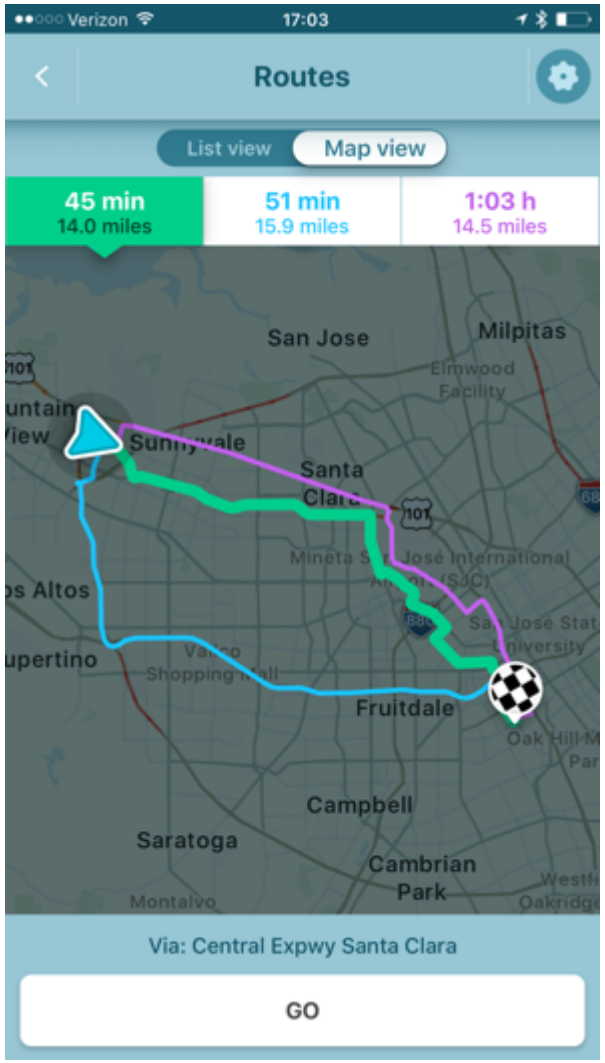
Bi-Directional Communication

Crew Resource Management

HAT in Navigation







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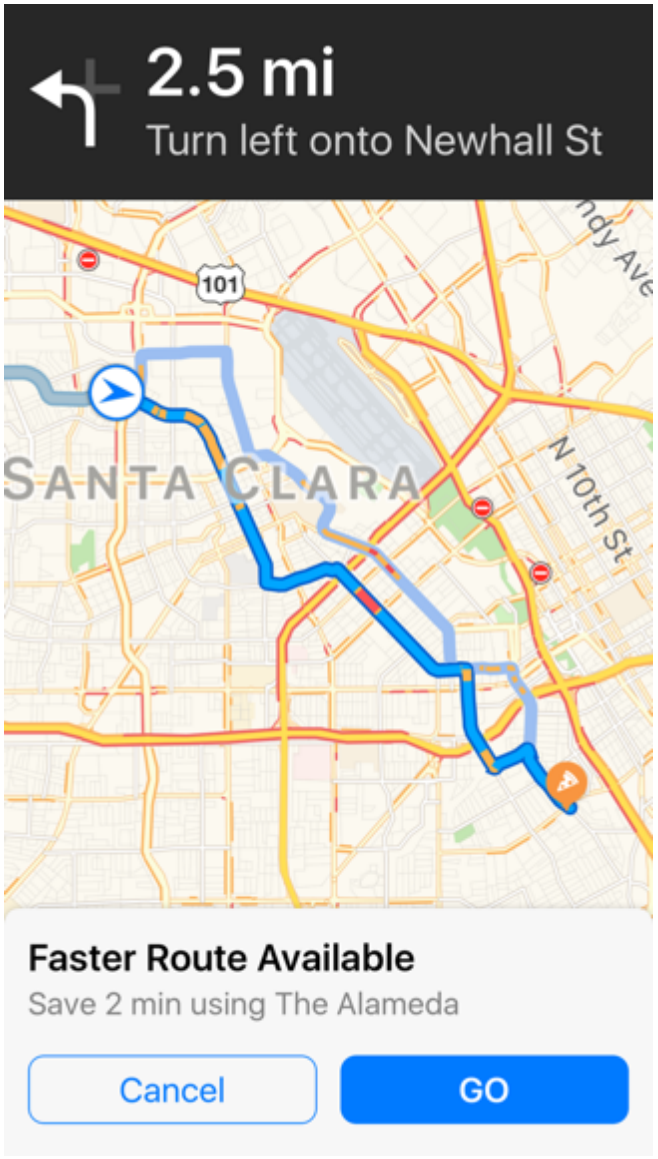
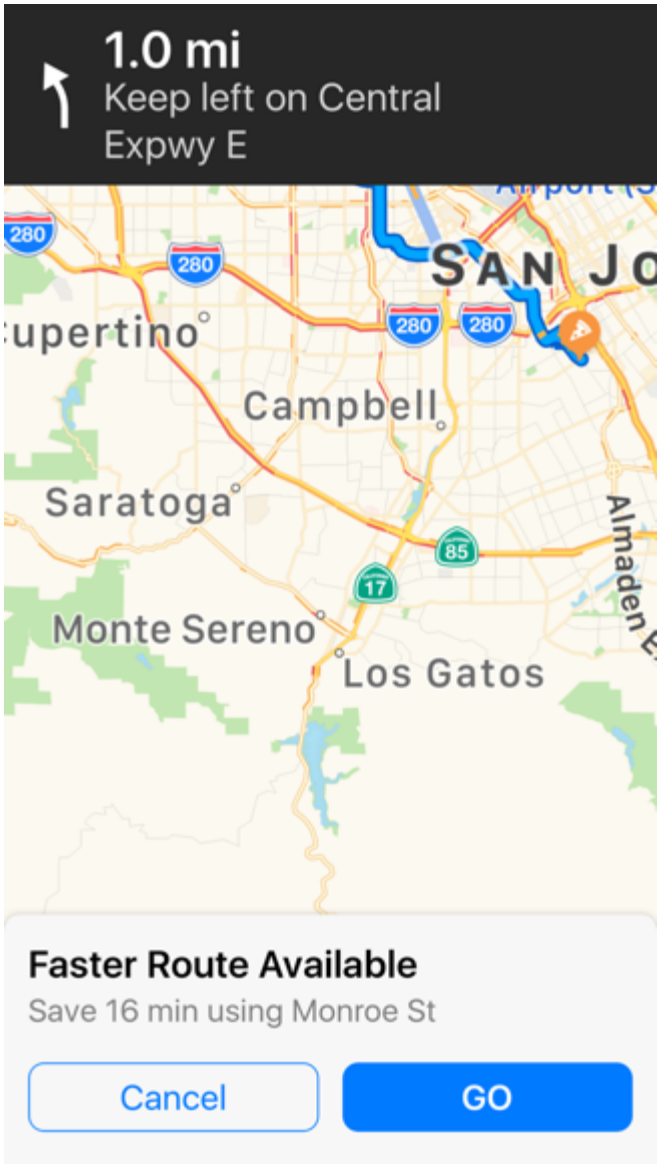
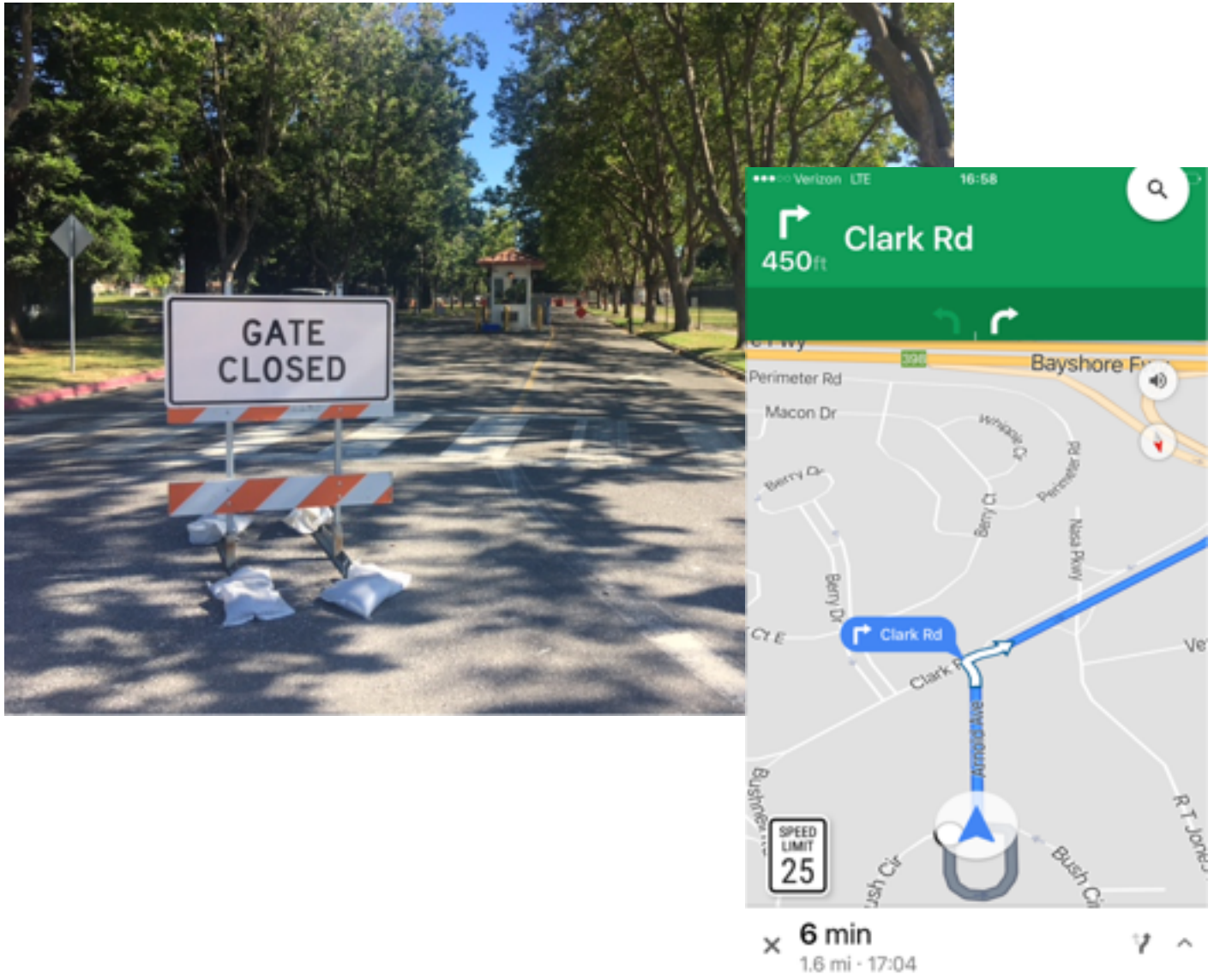
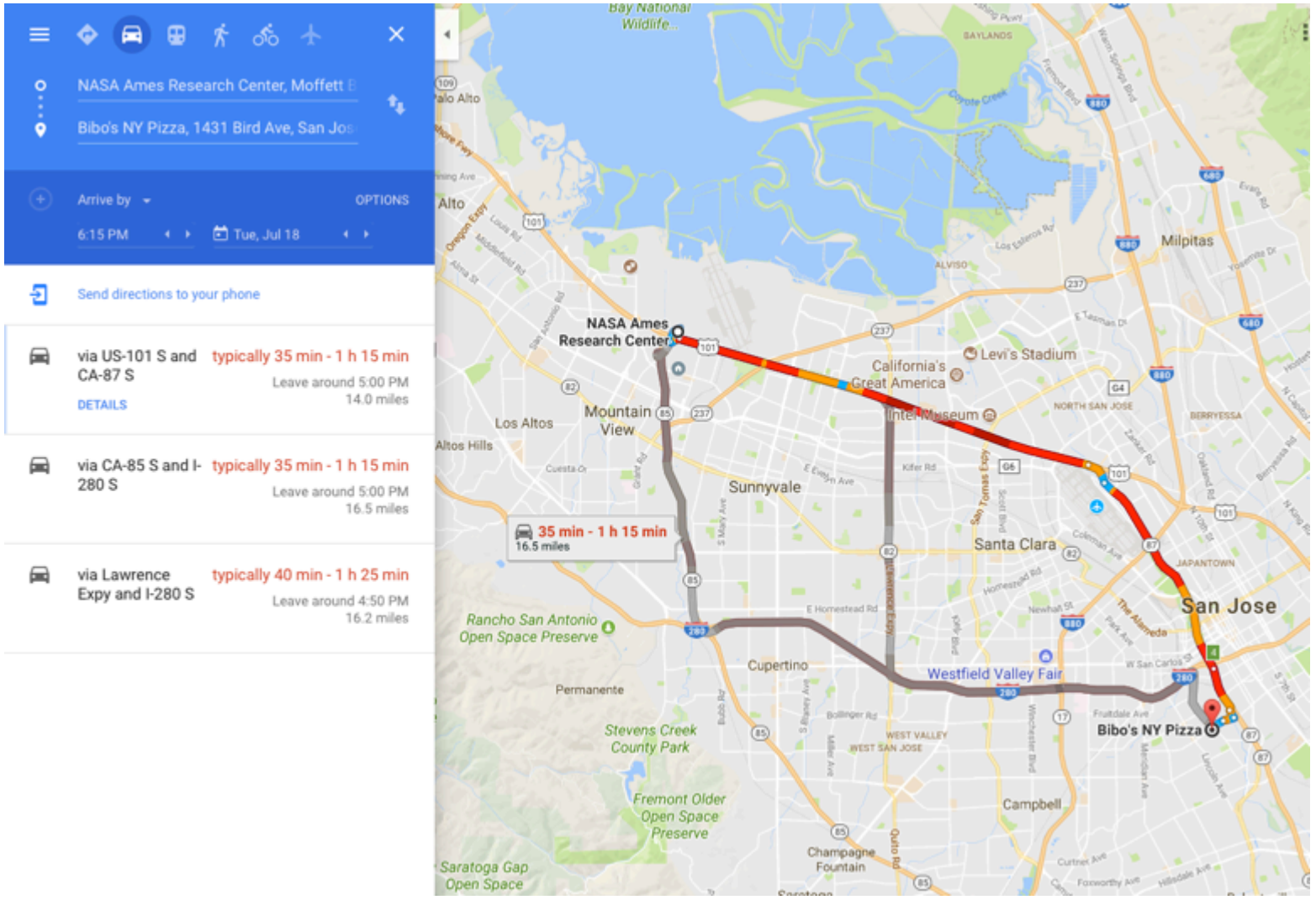




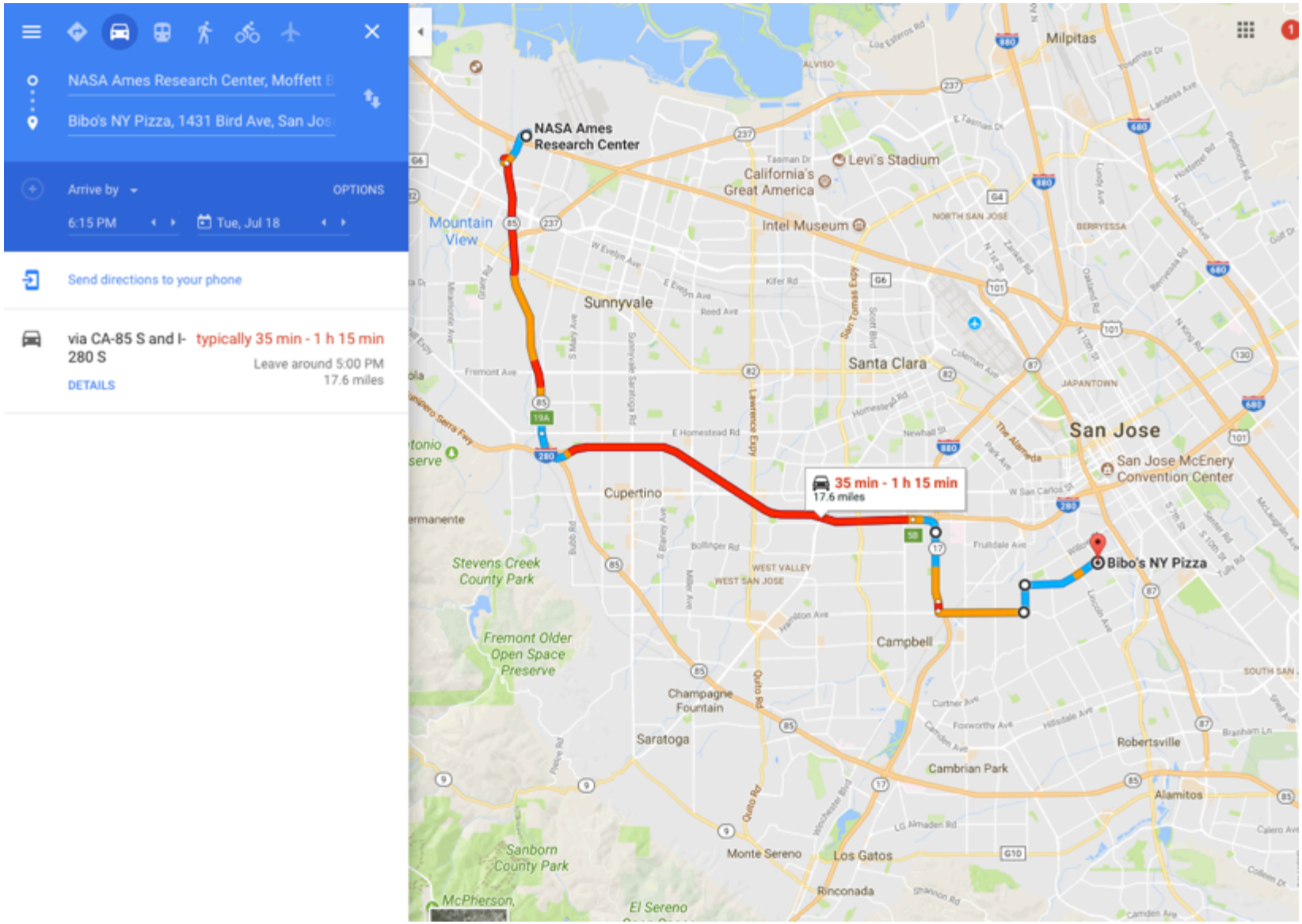
HAT in Navigation



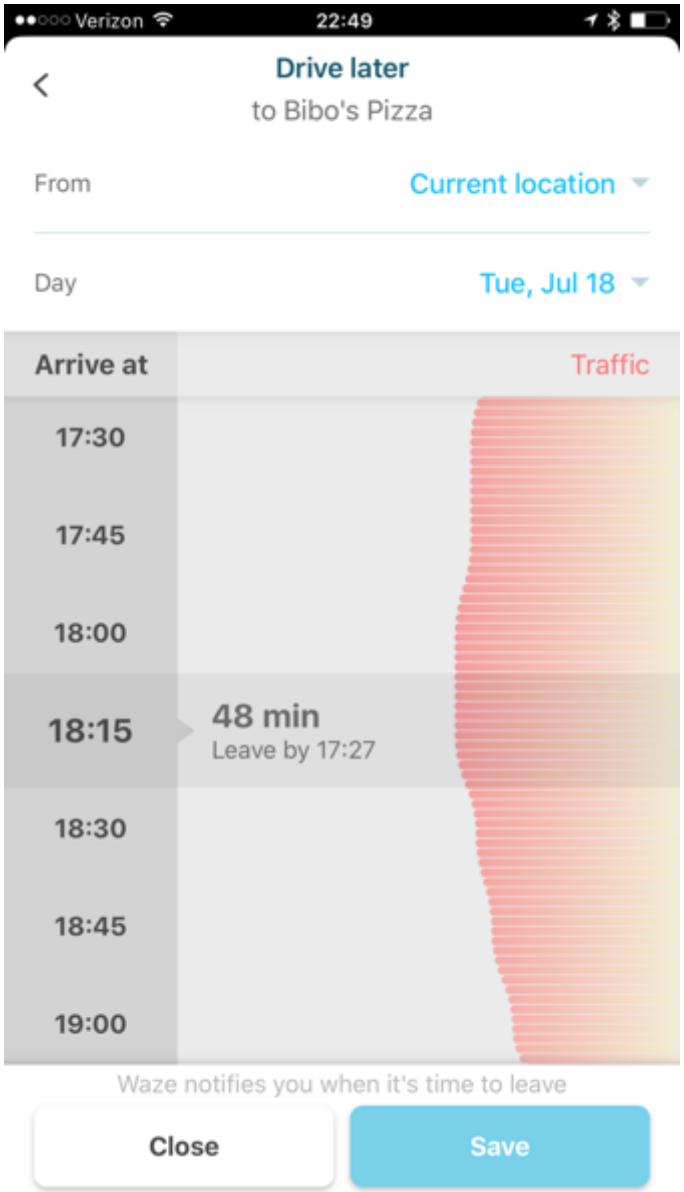
HAT in Navigation

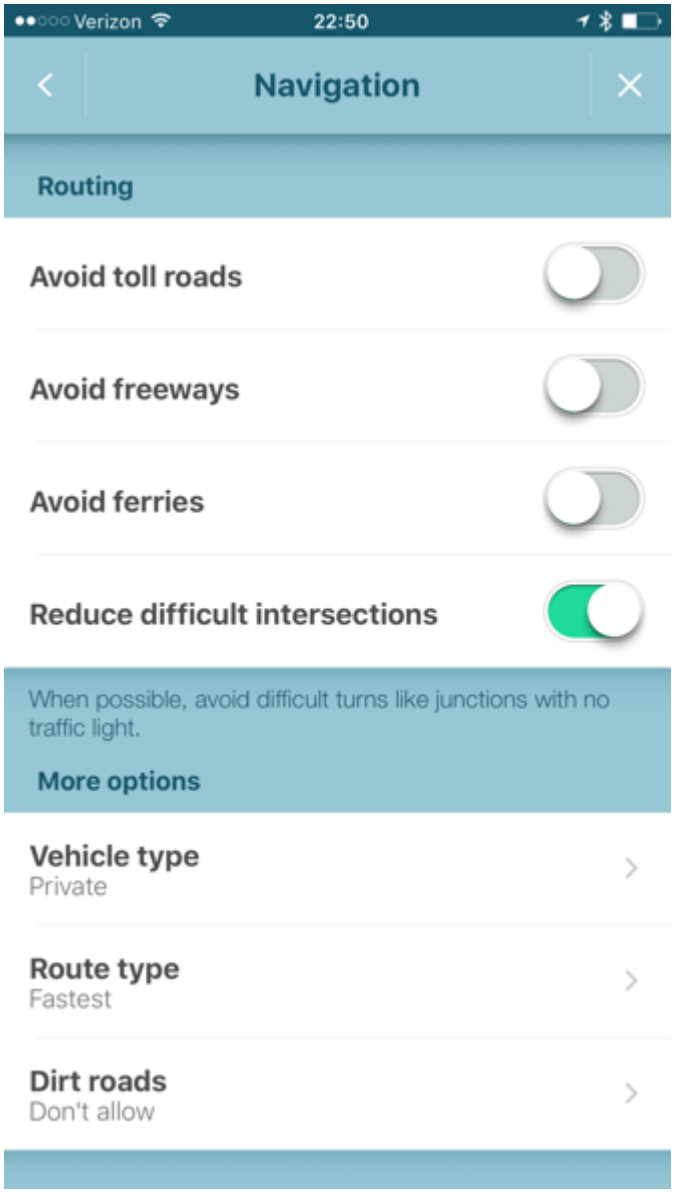


HAT in Navigation



HAT in Navigation





HAT in Navigation

Routes → Plays

- Specify alternate routes in advance
- Specify conditions for deviation from route
  - E.g., only if it saves > 10 minutes
- User can specify preferences
  - I don't like surface streets
  - I like 280 better than 101
  - I am a carpool

Bi-Directional Communication

- Why is it choosing this route?
- If I have a route specified in advance automation can use a common language to inform me about it

HAT in Photography

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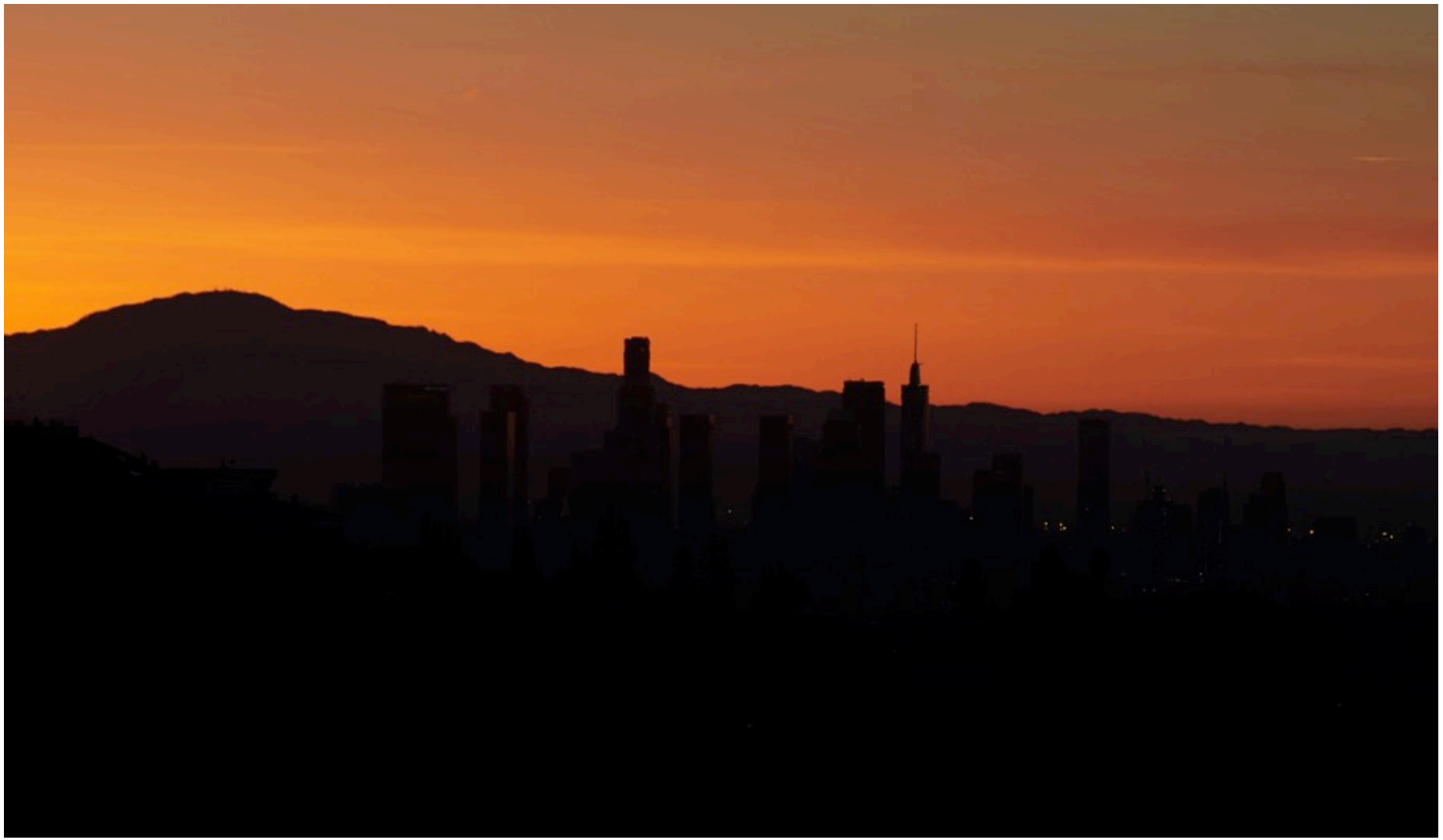
HAT in Photography



HAT in Photography

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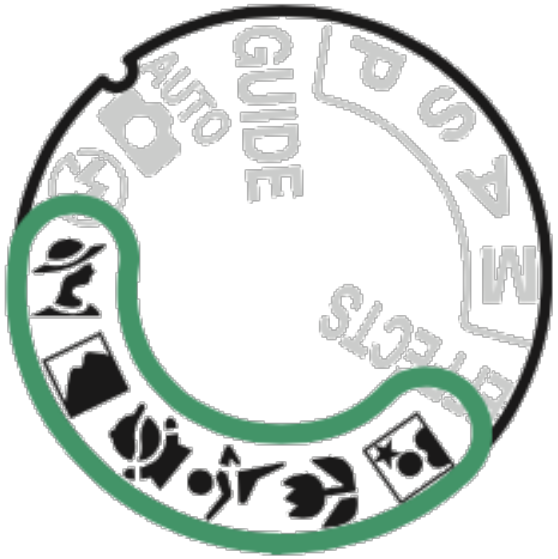
HAT in Photography

Scene Modes

- Shared Goals ✔(sort of)



Portrait	Sports
Landscape	Close up
Child	Night Portrait

HAT in Photography

Scene Modes

- Shared Goals ✔ (Sort of)
- Transparency ✘
- Shared Plans ✘
- Etc. ✘

Landscape

Use for vivid landscape shots in daylight.

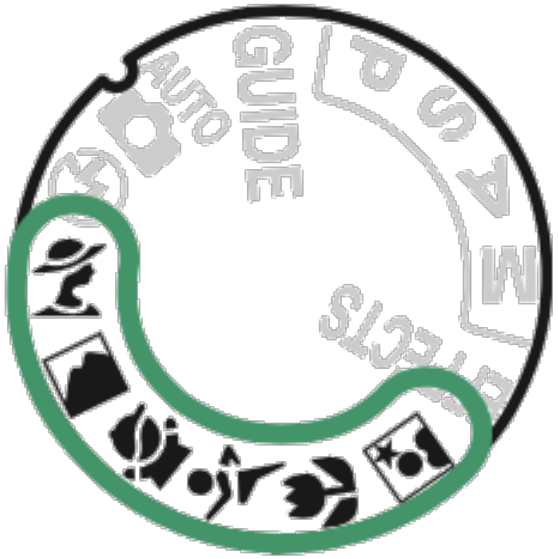
Note

The built-in flash and AF-assist illuminator turn off.

HAT in Photography

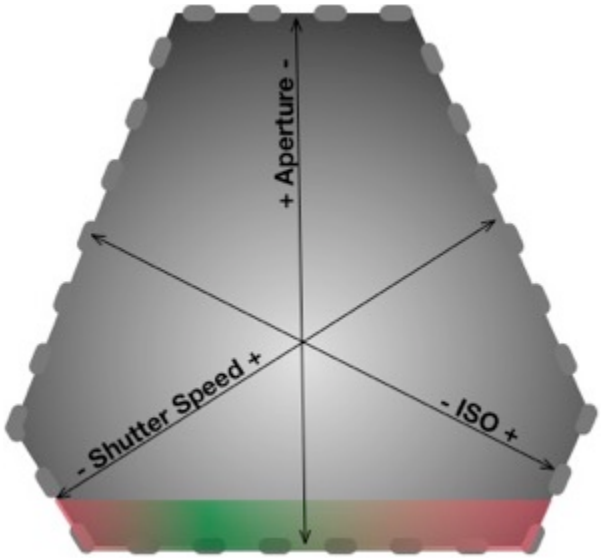
Scene Modes → Plays

- User modifiable plans
  - Modifiable offline
  - Adaptable online



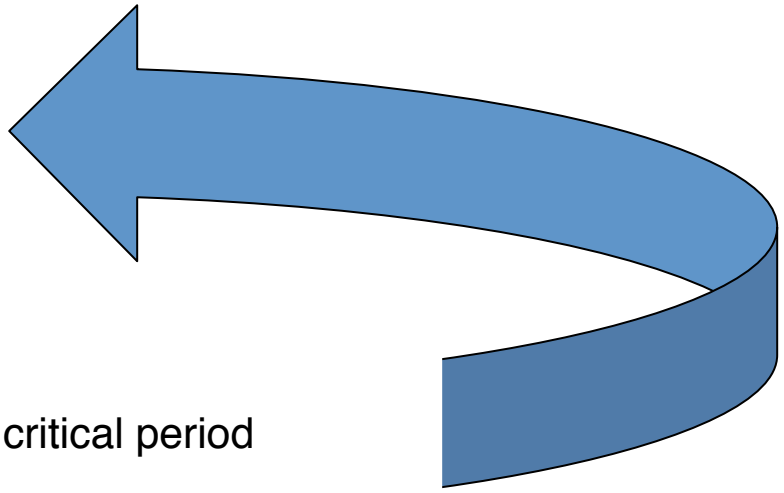
Bi-Directional Communication

- User can tell automation goals
- Automation informs user about whether goals are being met



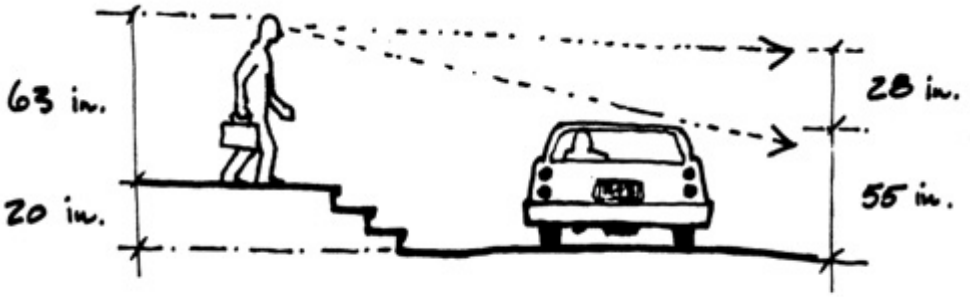
Lessons

- HAT seems applicable to a wide variety of automation
- Interaction with the automation can profitably be broken into phases based on time constraints
  - Real-time
    - Time constraints
    - Interface constraints
    - Still need
      - Transparency
      - Shared goals
      - Delegation
      - Etc.
  - Offline
    - Plays/SOPs
    - Move negotiation to less time critical period
    - Create a shared language

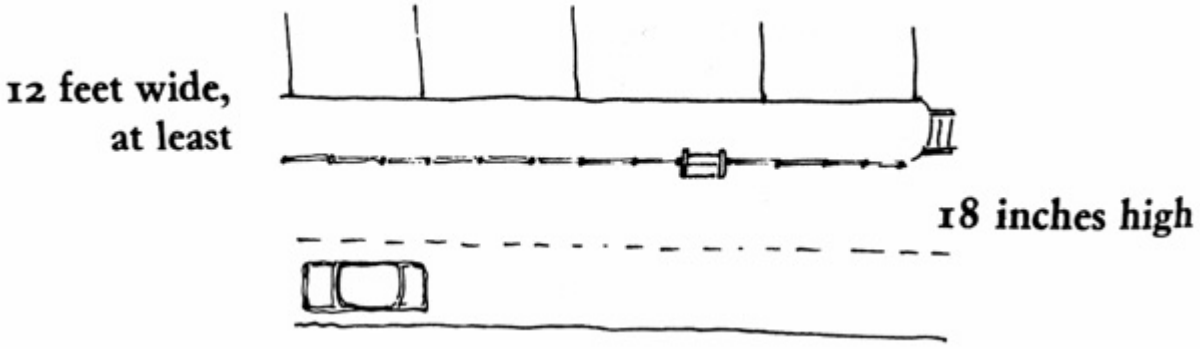


Design Patterns

- In other domains, people have attempted to capture similar problem-solution pairs using “design patterns”
  - Architecture and Urban Planning (Alexander, et al., 1977)
    - E.g., Raised Walkways solve the problem of making pedestrians feel comfortable around cars

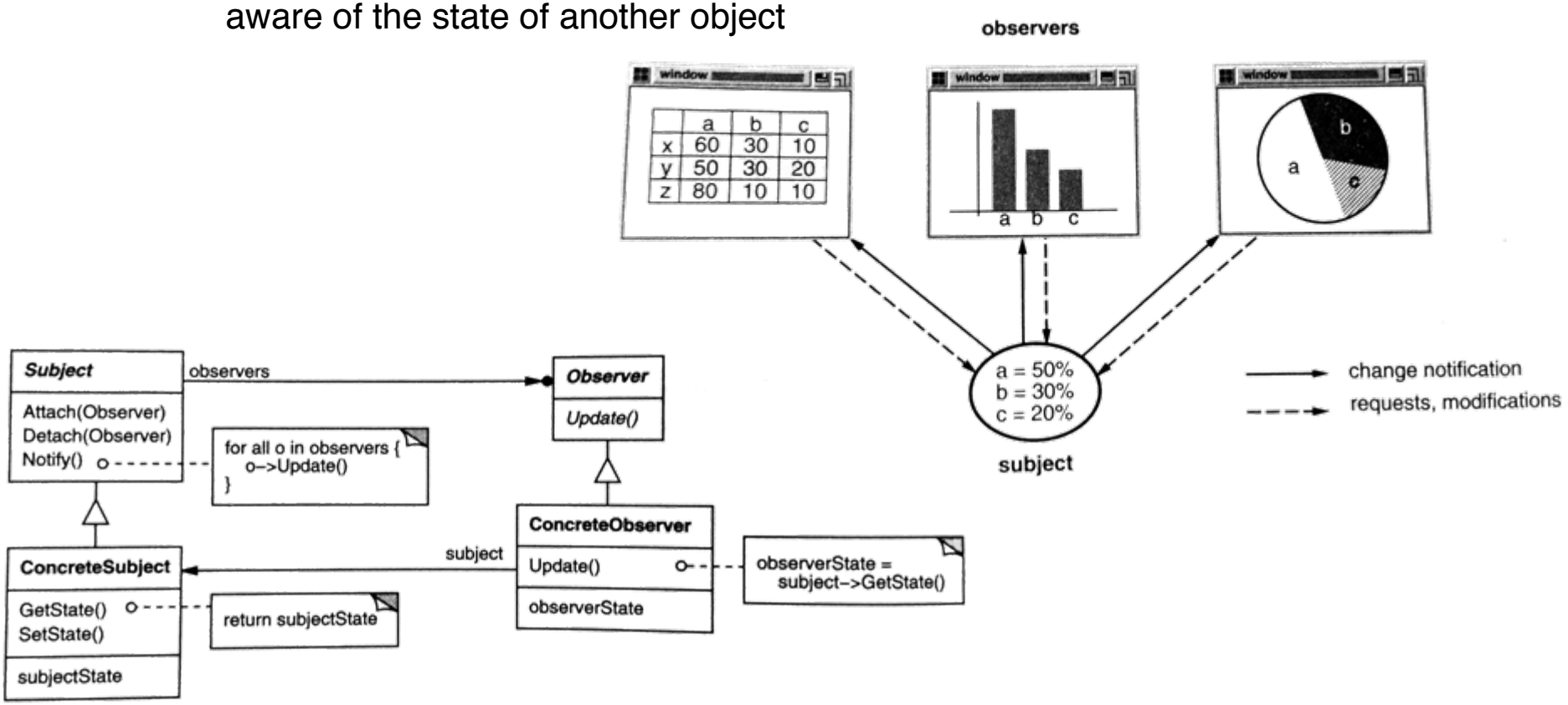


Keep the cars below a person's line of sight.



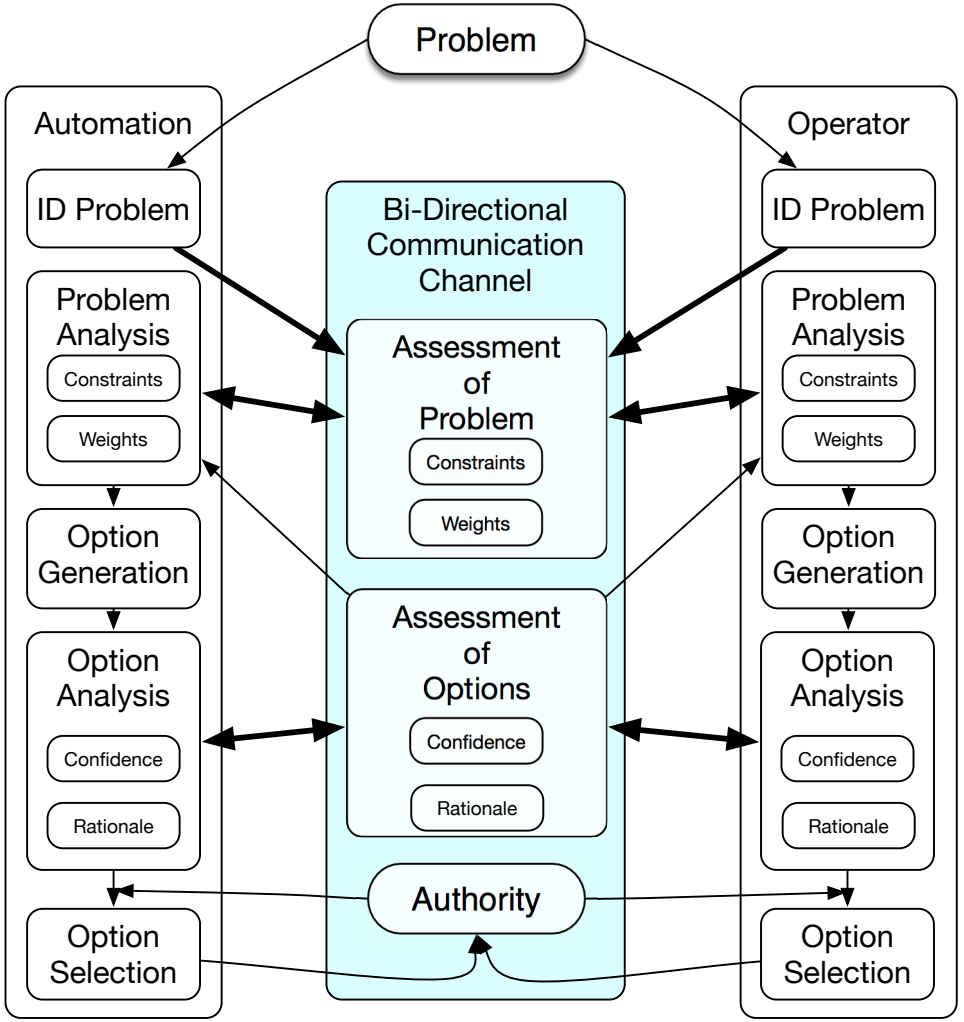
Design Patterns

- In other domains, people have attempted to capture similar problem-solution pairs using “design patterns”
  - Computer Programming (Gamma, et al., 1994)
    - E.g., Observers solve the problem of maintaining keeping one object aware of the state of another object

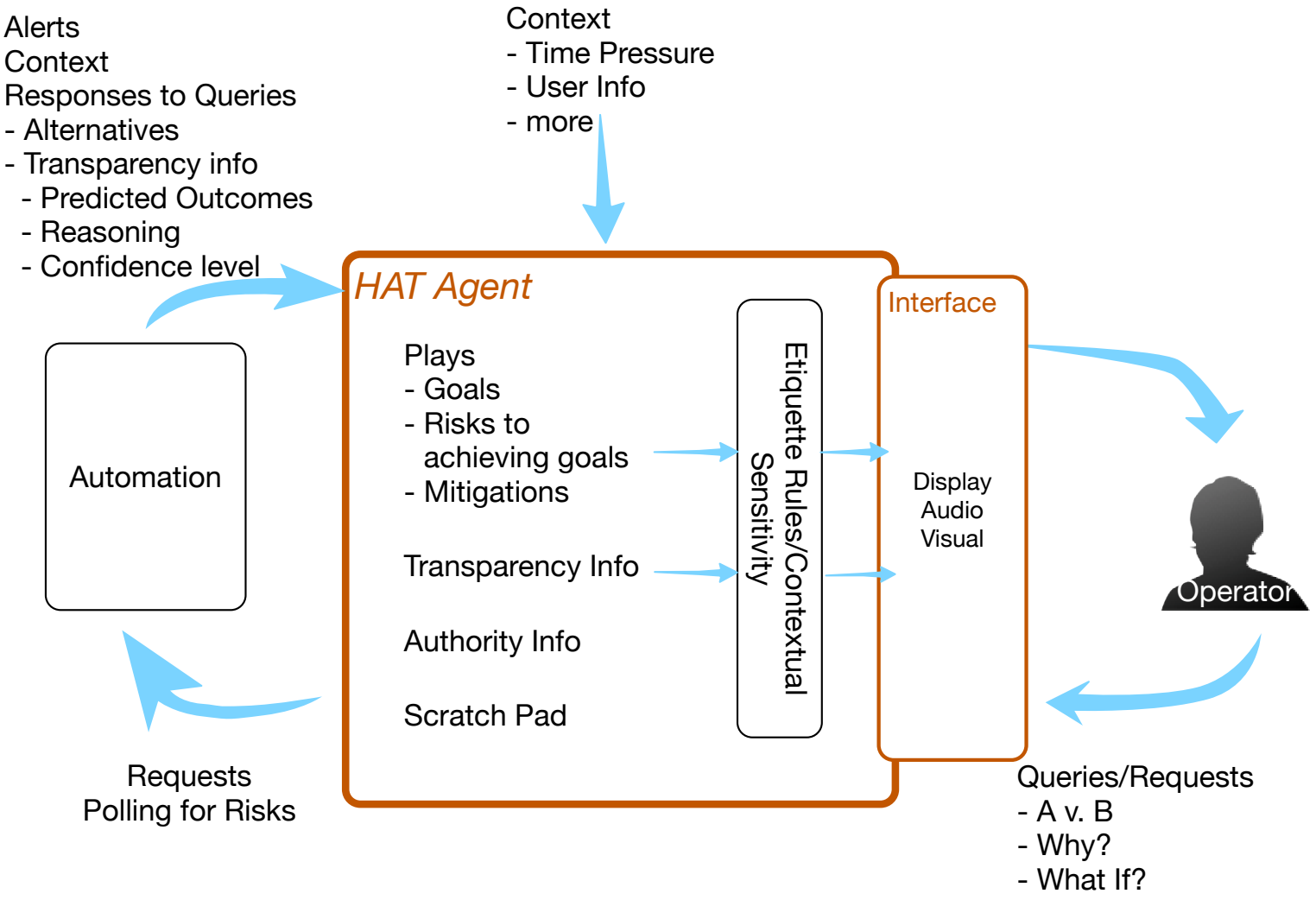


Design Patterns for HAT

- NATO HAT working group is trying to develop a set of design patterns for HAT
- Working with Gilles Coppin on a Bi-Directional Communication pattern
- Modeled after Gamma et al specifications:
  - Intent: Support generation of input from all relevant parties and its integration into decisions
  - Motivation: Reduce brittleness of the system by consolidating information and skills
  - Applicability: May not be applicable in urgent situations or with automation that lacks structure (e.g., neural networks)



HAT Agent


Alerts
Context
Responses to Queries
- Alternatives
- Transparency info
- Predicted Outcomes
- Reasoning
- Confidence level
Context
- Time Pressure
- User Info
- more
HAT Agent
Plays
- Goals
- Risks to achieving goals
- Mitigations
Transparency Info
Authority Info
Scratch Pad
Etiquette Rules/Contextual Sensitivity
Interface
Display
Audio
Visual
Automation
Operator
Requests
Polling for Risks
Queries/Requests
- A v. B
- Why?
- What If?

Thank you!