



University of Colorado
Boulder

Human-Robot Interaction

Methodological Fit & Project Work Session 1

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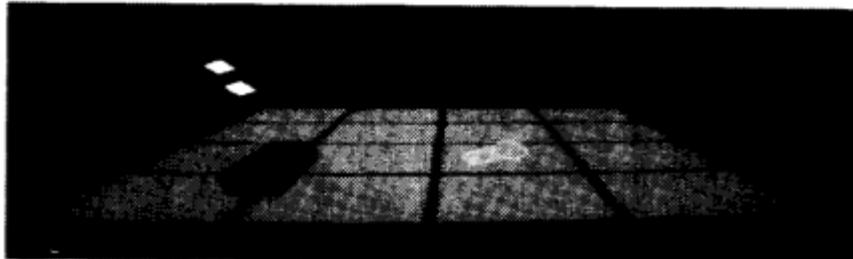
Video of the Day

[Programming a robot using an Oculus Rift](#)

Laboratory for Computational Sensing + Robotics
Johns Hopkins University



Compare with...



virtual initial state
(upper left rectangular objects represent virtual robot grippers)



pick_up PEG GREEN



put PEG GREEN on BLOCK RED
(a) Operator's actions and recognized commands



actual initial state



intermediate state



final state

(b) Robot movements in actual workplace
Figure. 9 Inserting a peg into a hole

Takahashi, Tomoichi, and Takashi Sakai. "Teaching robot's movement in virtual reality." *IEEE/RSJ International Workshop on Intelligent Robots and Systems (IROS'91)*. IEEE, 1991.

Compare with...



Fig. 10. View into the CIROS environment in the virtual reality representation.



Fig. 12. Experienced users want to see the robots.

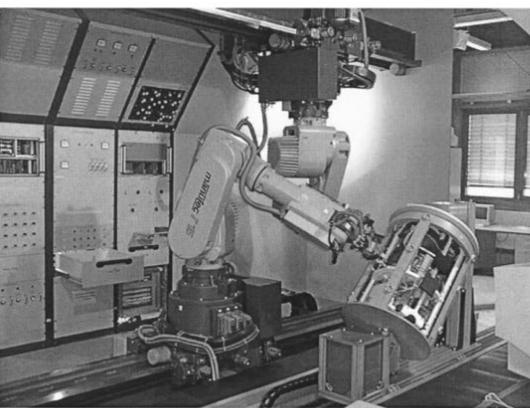


Fig. 11. View into the CIROS testbed while the robots are working on the satellite.

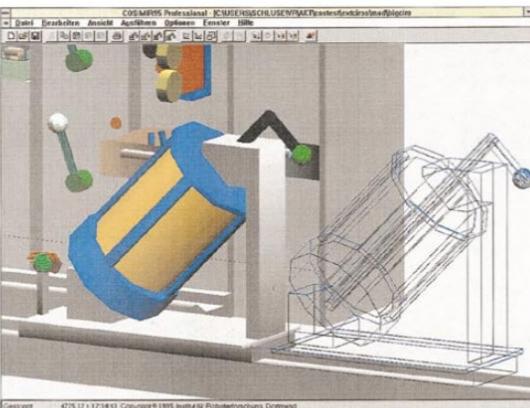


Fig. 13. Positions of physical objects are represented as wireframes.

Freund, Eckhard, and Juergen Rossmann.
"Projective virtual reality: Bridging the gap
between virtual reality and robotics." *IEEE
Transactions on Robotics and Automation* 15.3
(1999): 411-422.

Previously...

Measurements

Self-reports

Observations

By visible or hidden observers

Archival records

Public or private

Trace records

Manipulation

Selection

Varying the population across conditions

Direct intervention

Varying the structure of, or process in, a system

Indirect inductions

Evoking varied responses

Summary

Methods dictate the results the researcher will obtain

This is why it is extremely important to report all details of your method

It is impossible to maximize all desirable features of a method

Hence we have “limitations” sections in our papers

You need to interpret your results in the light of other related results

This is why we include relevant background in our papers and interpret our results in the light of the results from this background

Research Methodology

Research strategies

Types of validity

Trade-offs

Next: choosing the right
method

“The key to good research lies not in choosing the right method, but rather in asking the right question and picking the most powerful method for answering that particular question.”

—Bouchard, 1976

Bouchard, T. J., Jr. (1976). Field research methods: Interviewing, questionnaires, participant observation, systematic observation, unobtrusive measures. In M. D. Dunnette (Ed.), *Handbook of industrial and organizational psychology*: 363– 413. Chicago: Rand McNally

The anatomy of a research
project

Methodological Fit

Internal consistency among elements of a research project

Research Question

Prior Work

Research Design

Contribution to Literature

1. Research Question

Goals of a research question:

Focus a study

Narrow the topic area to a meaningful, manageable size

Address issues of theoretical and practical significance

Point towards a viable research project – that is, the question can be answered

2. Prior Work

Prior work represents

The state of the literature

Existing theoretical and empirical research papers that pertain to the topic of the current study

An aid in identifying unanswered questions, unexplored areas, relevant constructs, and areas of low agreement

3. Research Design

Defines

Type of data to be collected

Data collection tools and procedures

Type of analysis planned

Finding/selection of sites for collecting data

4. Contribution to Literature

Components

The new theory developed as outcome of the study

New ideas that contest conventional wisdom, challenge prior assumptions, integrate prior streams of research to produce a new model, or refine understandings of a phenomena

Any practical insights drawn from the findings that may be suggested by the researcher (e.g., design guidelines, new data set, optimization technique)

How to determine fit

Determining Fit

State of the current theory

A given, fixed context in which new research is developed

The only element over which the researcher has no control

From *nascent* to *mature*

Nascent Theory

Proposes tentative answers to novel questions

Suggesting new connection among phenomena

Intermediate Theory

Presents provisional explanations of phenomena

Introduces a new construct

Proposes relationships between new and existing constructs

May be made up of testable hypotheses and tentative constructs

Mature Theory

Presents well-developed constructs and models

Has been studied over time with increasing precision by a variety of scholars

Consists of points of broad agreement

Research Questions

Nascent:

Open-ended inquiry about a phenomenon of interest

Intermediate:

Proposed relationships between new and established constructs

Mature:

Focused questions and/or hypotheses relating existing constructs

Type of Data Collected

Nascent:

Qualitative, initially open-ended data that need to be interpreted for meaning

Intermediate:

Hybrid (both qualitative and quantitative)

Mature:

Quantitative data; focused measures where extent or amount is meaningful

Data Collection Methods

Nascent:

Interviews; observations; obtaining documents or other material from field sites relevant to the phenomena of interest

Intermediate:

Interviews; observations; surveys; obtaining material from field sites relevant to the phenomena of interest

Mature:

Surveys; interviews or observations designed to be systematically coded and quantified; obtaining data from field sites that measure the extent or amount of salient constructs

Constructs and Measures

Nascent:

Typically new constructs, few formal measures

Intermediate:

Typically one or more new constructs and/or new measures

Mature:

Typically relying heavily on existing constructs and measures

Goals of Data Analysis

Nascent:

- Pattern identification

Intermediate:

- Preliminary or exploratory testing of new propositions and/or new constructs

Mature:

- Formal hypothesis testing

Data Analysis Methods

Nascent:

Thematic content analysis coding for evidence of constructs

Intermediate:

Content analysis, exploratory statistics, and preliminary tests

Mature:

Statistical inference, standard statistical analyses

Theoretical Contribution

Nascent:

A suggestive theory, often an invitation for further work on the issue or set of issues opened up by the study

Intermediate:

A provisional theory, often one that integrates previously separate bodies of work

Mature:

A supported theory that may add specificity, new mechanisms, or new boundaries to existing theories

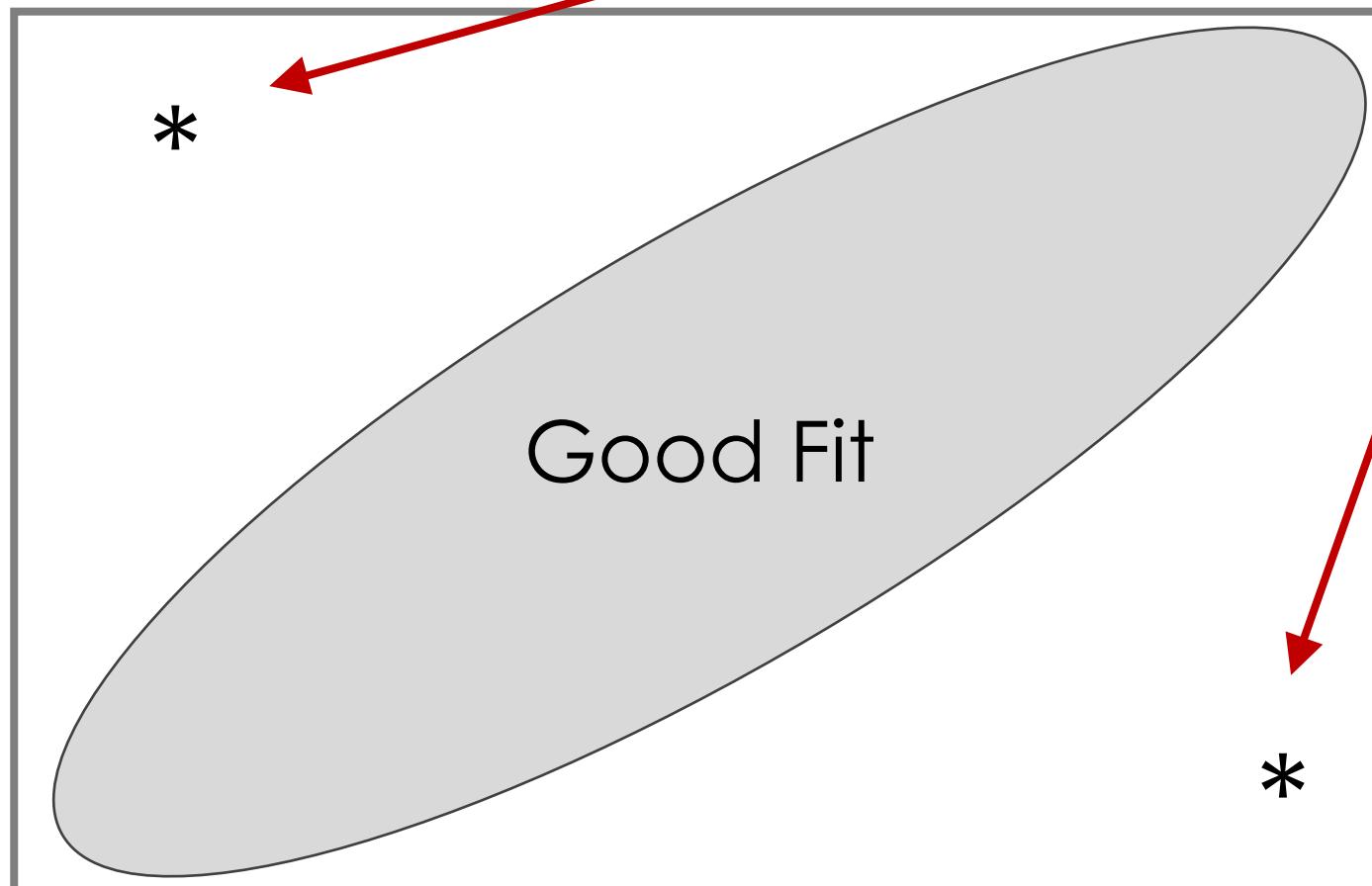
Exceptions with good fit

Quantitative

Data

Hybrid

Qualitative



Nascent

Intermediate

Mature

Theory

Questions?

Problems with low fit

Prior Work Data Problems Outcome

Nascent

Little or no prior work on the constructs and process under investigation

Quantitative only

Fishing expeditions

Results vulnerable to finding significant associations among novel constructs and measures by chance

Research falls too far outside guidelines for statistical inference to convince others of its merits

Hybrid

Quantitative measures with uncertain relationship to phenomena

Emergent constructs may suggest new measures for subsequent research, but statistical tests using same data that suggested the constructs are problematic

Prior Work Data Problems Outcome

Intermediate

One or more streams of relevant research, offering some but not all constructs and measures needed

Quantitative only

Uneven status of empirical measures

New constructs and measures lack reliability and external validity and suffer in comparison to existing measures

Results are less convincing,

reducing potential contribution to the literature and influence on others' understanding of the topic

Qualitative only

Lost opportunity

Insufficient provisional support for a new theory lessens paper's contribution

Prior Work Data Problems Outcome

Mature

Extensive literature, complete with constructs and previously tested measures

Hybrid

Uneven status of evidence

Paper is lengthened but not strengthened by using qualitative data as evidence

Research fails to build effectively on prior work to advance knowledge about the topic

Qualitative only

Reinventing the wheel

Study findings risk being obvious or well-known

Questions?

Discussion Questions

When should (robotic) service staff initiate interaction with a visitor?

Kato, Yusuke, Takayuki Kanda, and Hiroshi Ishiguro. "May I help you?: design of human-like polite approaching behavior." *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction*. ACM, 2015.

How to find a method to moderate the abuse of robots in public settings?

Bršić, Drazen, et al. "Escaping from Children's Abuse of Social Robots." *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction*. ACM, 2015.

Can children catch curiosity from a social robot?

Gordon, Goren, Cynthia Breazeal, and Susan Engel. "Can Children Catch Curiosity from a Social Robot?." *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction*. ACM, 2015.

Project Work

Groups

Mutian Yan

Abhishek Suresh

Adam Pollins

Isabella Huang

Matthew Luebers

Aastha Acharya

Vishwajeet Narwal

Gabriella Johnson

Vinitha Gadiraju

Prajnya Satish

Brainstorming

You all indicated similar topics of interest

But your project doesn't have to be exactly what anyone pitched
Try to find an area of common ground

Determine

What is your research question?

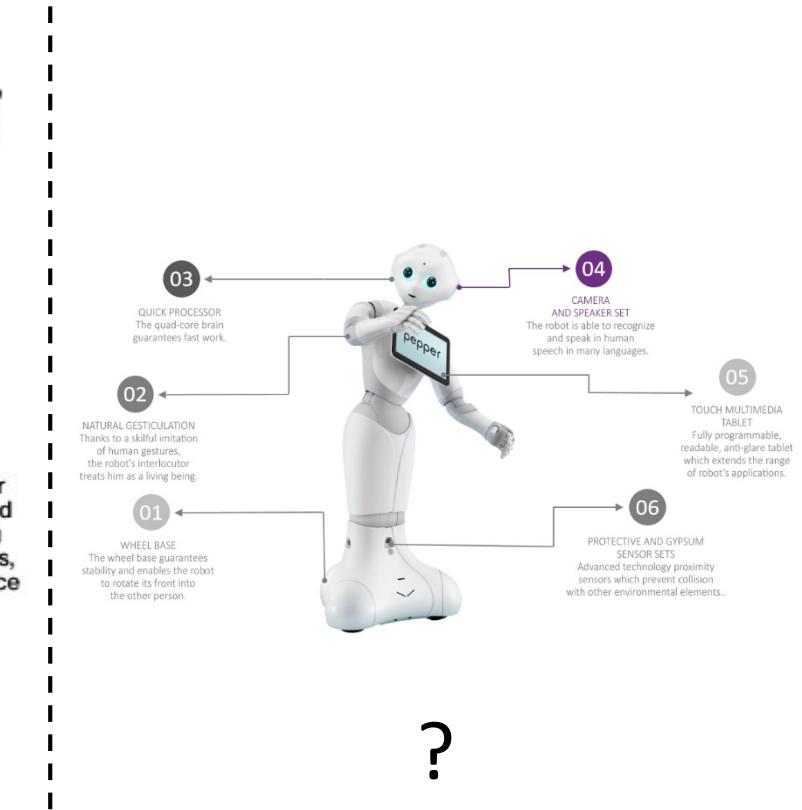
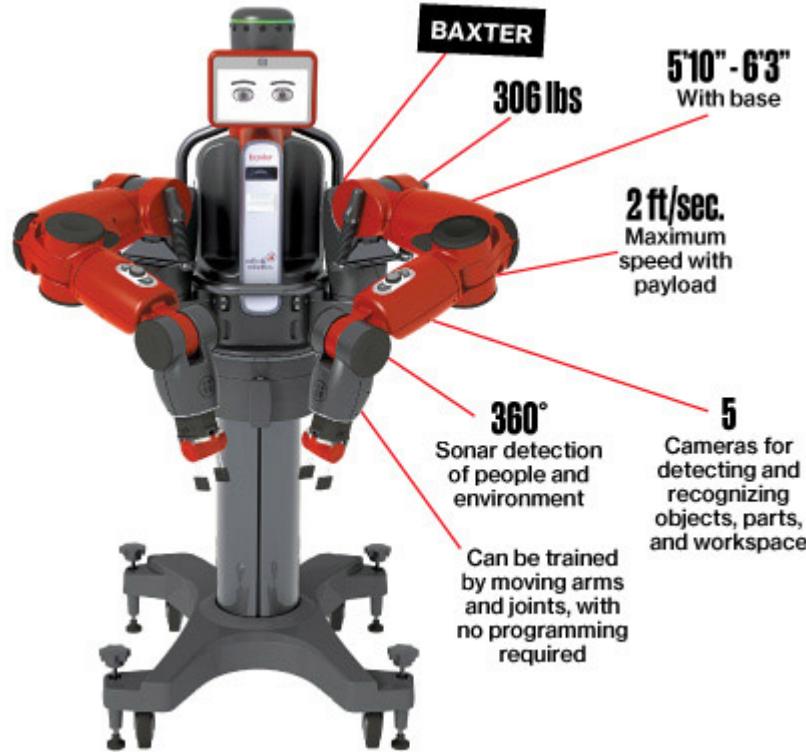
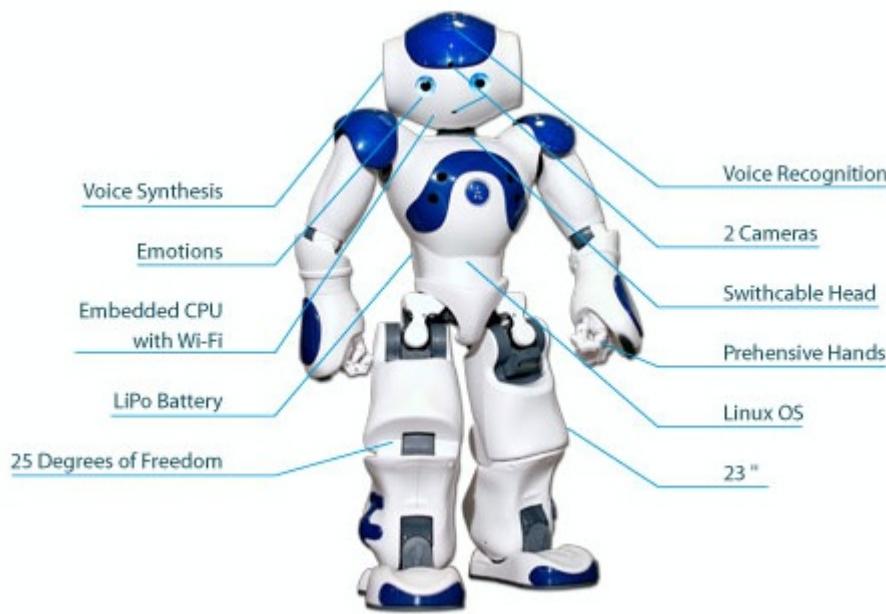
How do you think you will go about answering it?

What resources (tools/robots/equipment/etc.) will you need?

What prior has been done in this space that can inform your investigation?

What do a few simple searches on Google Scholar yield?

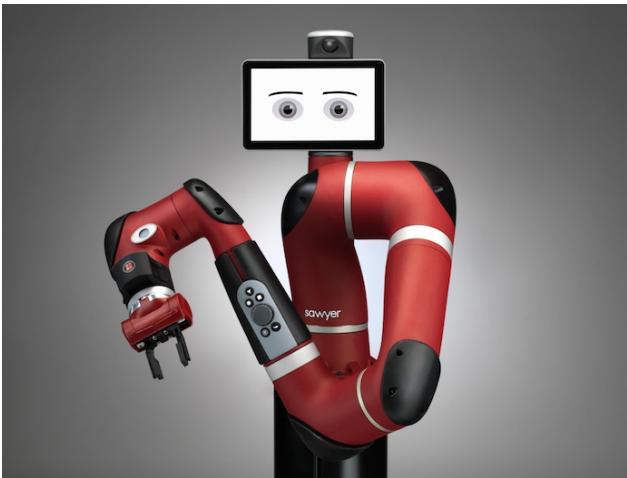
Resources: Humanoid Robots



Resources: Ground Robots



Resources: Manipulators



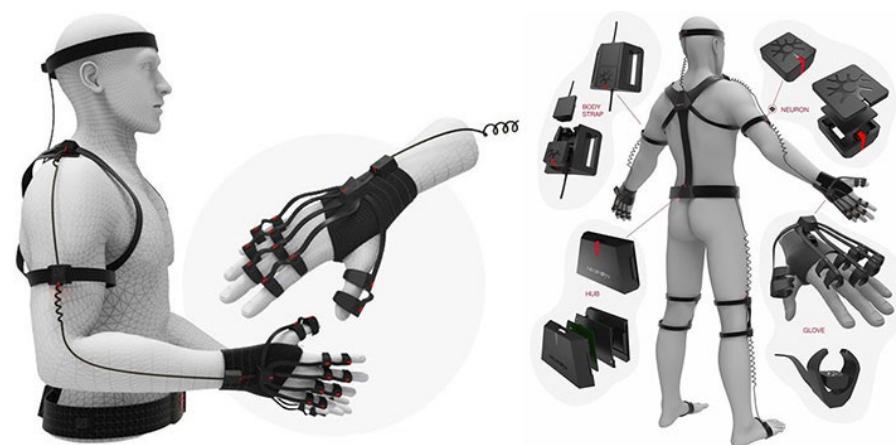
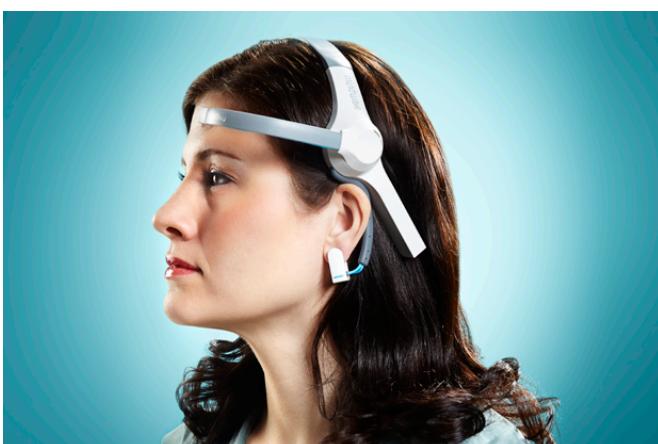
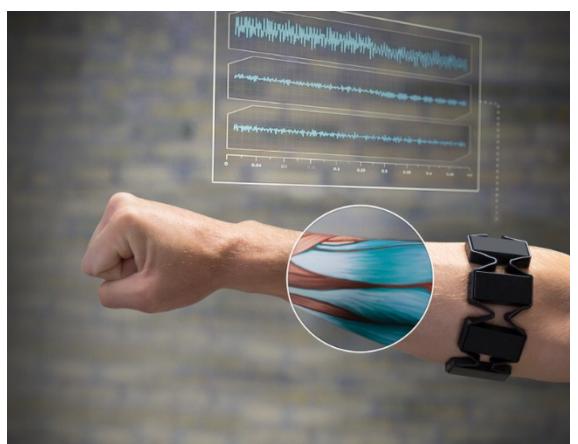
Resources: Telepresence Robots



Resources: Flying Robots



Resources: Sensors



Resources: AR and VR



Resources: Space and Knowledge

[IRON Lab](#) (ATLAS 200)

[Correll Lab](#) / [ARPG](#) / [CAIR](#) Lab (we will tour)

[COHRINT](#) Lab / Fleming Space

Possibly more

Next

Reading #3: Form, Morphology, and Embodiment

Posted on Moodle

Due **Wednesday**

Pro and Con presentations

Lecture: Choosing the right methodology

Project

Preliminary group presentation on **Monday, February 11**

Brainstorming

You all indicated similar topics of interest

But your project doesn't have to be exactly what anyone pitched
Try to find an area of common ground

Determine

What is your research question?

How do you think you will go about answering it?

What resources (tools/robots/equipment/etc.) will you need?

What prior work has been done in this space that can inform your investigation?

How will you ensure **good fit**?



University of Colorado
Boulder

THANKS!

Professor **Dan Szafir**

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