

# Systems Thinking and Software Engineering Ethics

CS 4320 / 7320

Software Engineering

Professor Sean P. Goggins

# Schedule

1. Today: Systems Thinking and Ethics
2. Thursday: Introduction to the next module: Design
3. Design Work in Groups (no classroom)
4. Design Work in Groups (no classroom)
5. HCI Design (Back in Classroom)

# Systems Theory

## Knowledge

Analysis

Decomposition

Break apart

## Understanding

Synthesis

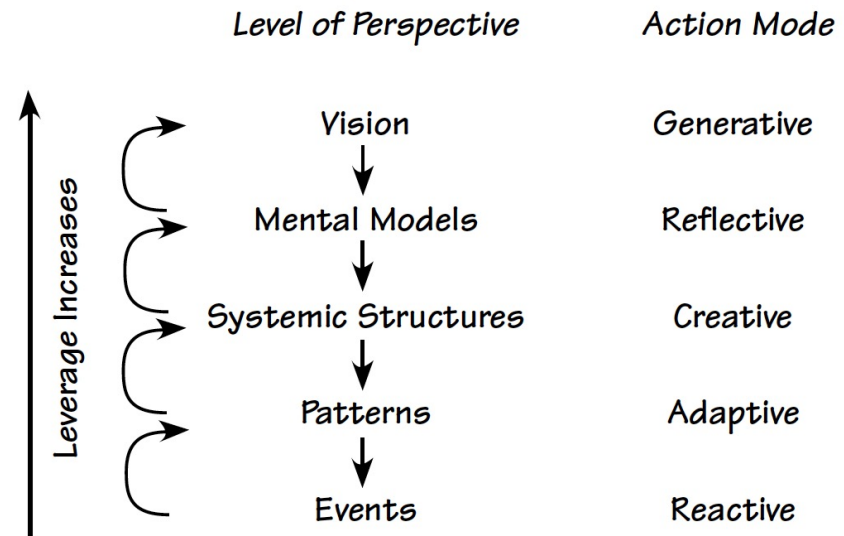
Finding Connections

Putting together

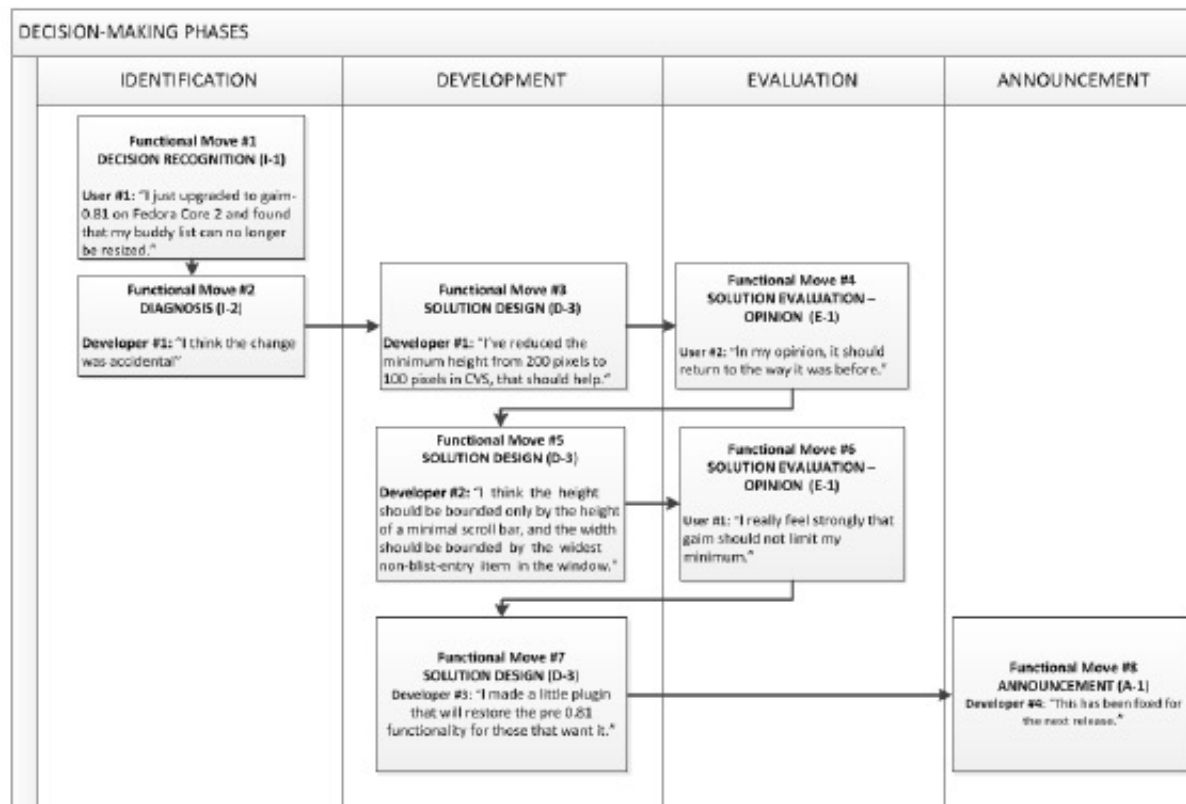
Software engineering is the understanding of unintended consequences.

Deterministic v Non-Deterministic Systems

# Systems Thinking Benefits: Less Reaction, More Strategy



# Systems Theory: Software Decision Making Phases (Eseryel, Wie & Crowston, 2020)



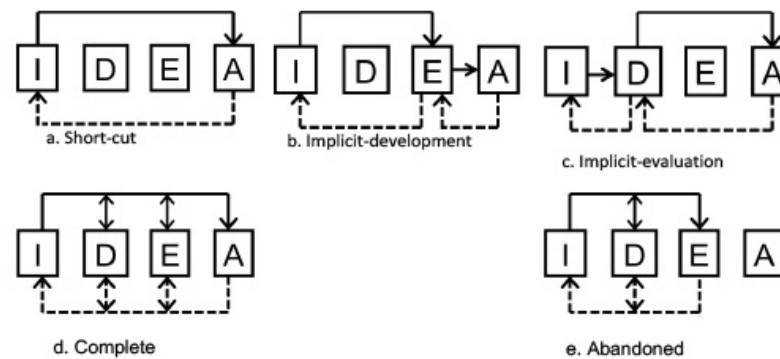
I – Idea  
 D – Development  
 E – Evaluation  
 A – Announcement

Yeliz Eseryel, U., Wie, K., & Crowston, K. (2020).  
 Decision-making Processes in Community-based  
 Free/Libre Open Source Software-development  
 Teams with Internal Governance: An Extension to  
 Decision-making Theory. *Communications of the  
 Association for Information Systems*, 484–510.  
<https://doi.org/10.17705/1CAIS.04620>

# Systems Theory: Software Decision Making Phases (Eseryel, Wie & Crowston, 2020)

I – Idea  
D – Development  
E – Evaluation  
A – Announcement

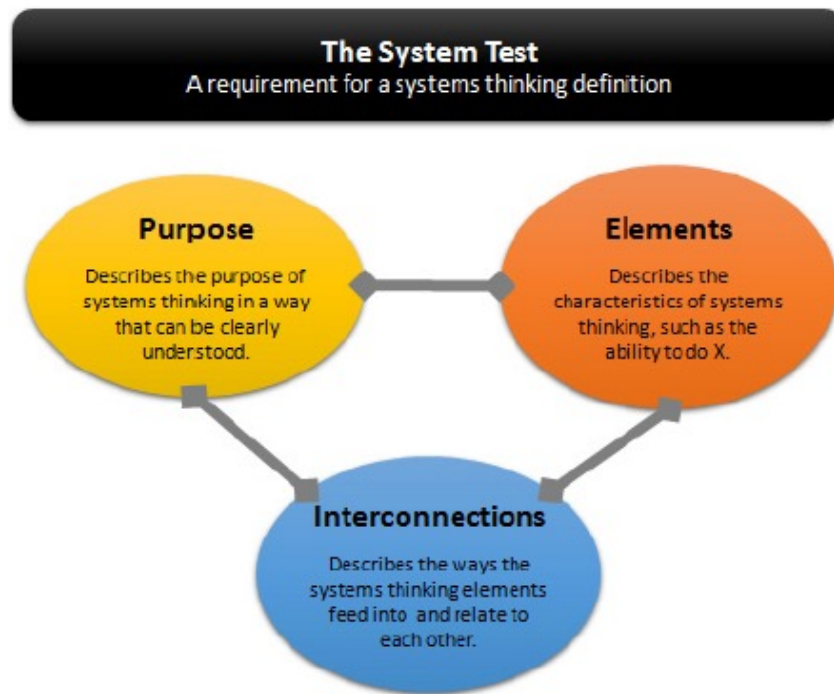
## Five Decision Making Patterns Among Open Source Teams



Yeliz Eseryel, U., Wie, K., & Crowston, K. (2020). Decision-making Processes in Community-based Free/Libre Open Source Software-development Teams with Internal Governance: An Extension to Decision-making Theory. *Communications of the Association for Information Systems*, 484–510. <https://doi.org/10.17705/1CAIS.04620>

# Recognizing a System (Arnold and Wade, 2015)

## The System Test



Arnold, R. D., & Wade, J. P. (2015). A Definition of Systems Thinking: A Systems Approach. *Procedia Computer Science*, 44, 669–678.  
<https://doi.org/10.1016/j.procs.2015.03.050>

# Recognizing a System (Arnold and Wade, 2015)

## Comparing Definitions

	Wholes Rather than parts	Interconnections / Relationships	Non-linear relationships	Stock and flow relationships	Dynamic Behavior	Feedback loops	Acknowledging that systems are important	System as the cause of its behavior	System structure generates behavior	Delays
Richmond	x				x	x		x	x	
Senge	x	x								
Rouse	x	x								
Sweeney and Sterman			x	x	x	x		x		x
Hopper and Stave	x	x		x	x	x		x	x	
Kopainsky, Alessi, and Davidsen			x			x				
Squires, Wade, Dominick, and Gelosh		x			x		x			
Forrester										

Arnold, R. D., & Wade, J. P. (2015). A Definition of Systems Thinking: A Systems Approach. *Procedia Computer Science*, 44, 669–678.

<https://doi.org/10.1016/j.procs.2015.03.050>

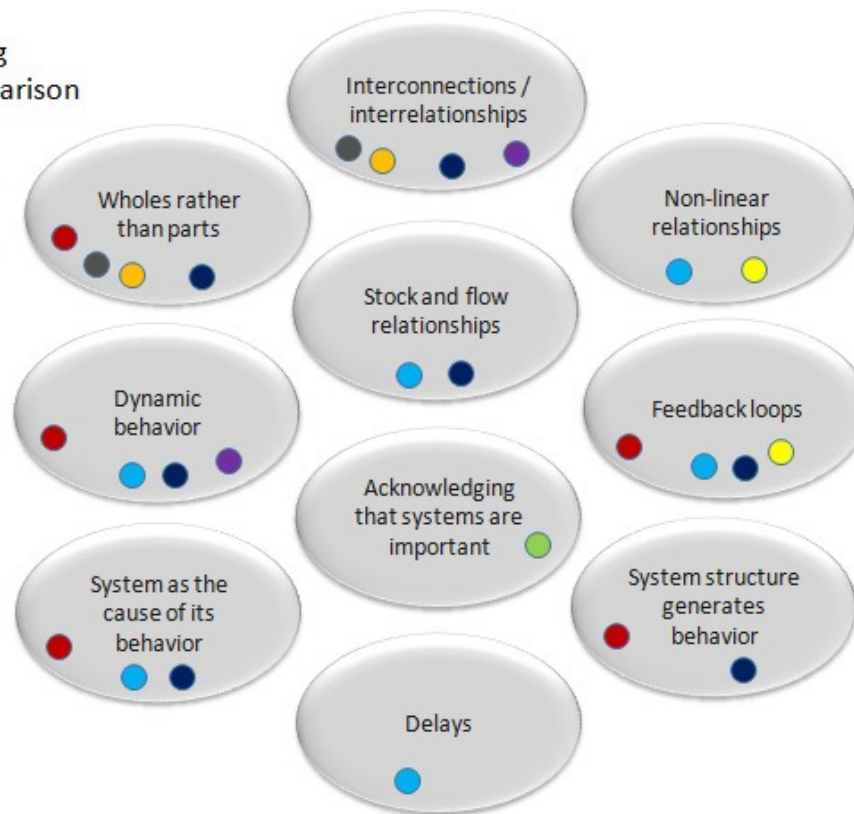


# Recognizing a System (Arnold and Wade, 2015)

## Comparing Definitions

Systems Thinking  
Definition Comparison

Author	Color
Richmond	Red
Senge	Grey
Rouse	Yellow
Sweeney and Sterman	Blue
Hopper and Stave	Dark Blue
Kopainsky, Alessi and Davidsen	Light Yellow
Squires, Wade, Dominick and Gelosh	Purple
Forrester	Green



Arnold, R. D., & Wade, J. P. (2015). A Definition of Systems Thinking: A Systems Approach. *Procedia Computer Science*, 44, 669–678.  
<https://doi.org/10.1016/j.procs.2015.03.050>

# Software Engineering Ethics

# Software engineering ethics

Software engineering involves wider responsibilities than simply the application of technical skills.

Software engineers must behave in an honest and ethically responsible way if they are to be respected as professionals.

Ethical behaviour is more than simply upholding the law but involves following a set of principles that are morally correct.

# Issues of professional responsibility

## Confidentiality

Engineers should normally respect the confidentiality of their employers or clients irrespective of whether or not a formal confidentiality agreement has been signed.

## Competence

Engineers should not misrepresent their level of competence. They should not knowingly accept work which is outwith their competence.

# Issues of professional responsibility

## Intellectual property rights

Engineers should be aware of local laws governing the use of intellectual property such as patents, copyright, etc. They should be careful to ensure that the intellectual property of employers and clients is protected.

## Computer misuse

Software engineers should not use their technical skills to misuse other people's computers. Computer misuse ranges from relatively trivial (game playing on an employer's machine, say) to extremely serious (dissemination of viruses).

# ACM/IEEE Code of Ethics

The professional societies in the US have cooperated to produce a code of ethical practice.

Members of these organisations sign up to the code of practice when they join.

The Code contains eight Principles related to the behaviour of and decisions made by professional software engineers, including practitioners, educators, managers, supervisors and policy makers, as well as trainees and students of the profession.

# Rationale for the code of ethics

*Computers have a central and growing role in commerce, industry, government, medicine, education, entertainment and society at large. Software engineers are those who contribute by direct participation or by teaching, to the analysis, specification, design, development, certification, maintenance and testing of software systems.*

*Because of their roles in developing software systems, software engineers have significant opportunities to do good or cause harm, to enable others to do good or cause harm, or to influence others to do good or cause harm. To ensure, as much as possible, that their efforts will be used for good, software engineers must commit themselves to making software engineering a beneficial and respected profession.*

# The ACM/IEEE Code of Ethics

## Software Engineering Code of Ethics and Professional Practice

ACM/IEEE-CS Joint Task Force on Software Engineering Ethics and Professional Practices

### **PREAMBLE**

The short version of the code summarizes aspirations at a high level of the abstraction; the clauses that are included in the full version give examples and details of how these aspirations change the way we act as software engineering professionals. Without the aspirations, the details can become legalistic and tedious; without the details, the aspirations can become high sounding but empty; together, the aspirations and the details form a cohesive code.

Software engineers shall commit themselves to making the analysis, specification, design, development, testing and maintenance of software a beneficial and respected profession. In accordance with their commitment to the health, safety and welfare of the public, software engineers shall adhere to the following Eight Principles:




# Ethical principles

1. PUBLIC - Software engineers shall act consistently with the public interest.
2. CLIENT AND EMPLOYER - Software engineers shall act in a manner that is in the best interests of their client and employer consistent with the public interest.
3. PRODUCT - Software engineers shall ensure that their products and related modifications meet the highest professional standards possible.
4. JUDGMENT - Software engineers shall maintain integrity and independence in their professional judgment.
5. MANAGEMENT - Software engineering managers and leaders shall subscribe to and promote an ethical approach to the management of software development and maintenance.
6. PROFESSION - Software engineers shall advance the integrity and reputation of the profession consistent with the public interest.
7. COLLEAGUES - Software engineers shall be fair to and supportive of their colleagues.
8. SELF - Software engineers shall participate in lifelong learning regarding the practice of their profession and shall promote an ethical approach to the practice of the profession.



Breakout  
Groups



Is this an  
ethics issue?

CVS sells your buying information to a third party.

Edward Snowden leaks classified US government information.

The Pennsylvania Legislature Subpoena's Personally identifying information from every citizen.

Cambridge Analytica analyzes Facebook data for political purposes

Researchers at a university analyze posts from a Twitter community

*What  
makes it an  
ethical  
issue?*

# *What makes it an ethical issue?*

*It generates the question, is this right or wrong?*

*Concerns your values and how they are applied in products and services*



## *What about Data Ethics?*

The volume & variety of information is increasing exponentially.

The ways of using these data (both for pure profit and for social good) is also increasing.

New  
“products”  
every day...

THE  
TECHNOLOGY  
HEADLINES

CHANNEL PARTNERSINDUSTRYSERVICESMAGAZINESTARTUP TWEETSCONFERENCES

Big Data

Jargon is Holding Businesses Back from New Technology Investment, says Epicor



Read More...

With technology jargon constantly changing, business professionals around the world are struggling to gain a proper understanding of the technologies they need to embrace, to shape the future of their businesses. This is one of the findings of a study from Epicor Software Corporation, a global provider of industry-specific enterprise software to promote business growth. The global survey of business decision makers and employees, which set out to understand the key drivers for business growth, has found a worrying lack of understanding around industry terminology.

Kodiak Data Introduces EdgeCache™ to Accelerate Access to Amazon S3 and S3-compliant Object Stores



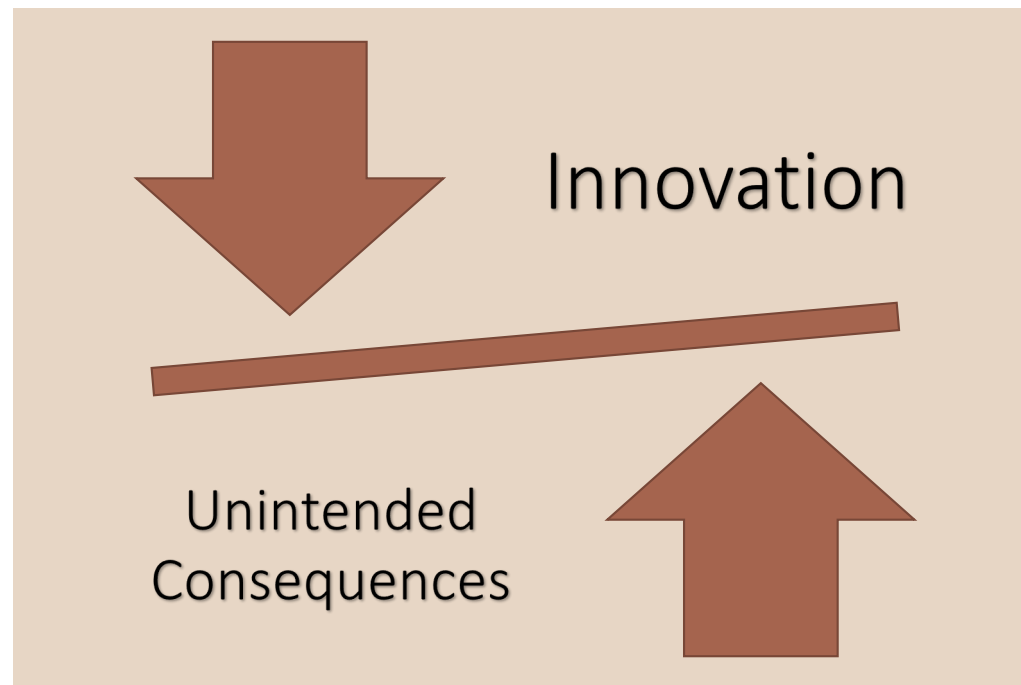
Read More...

Kodiak Data today announced general availability of EdgeCache™, a transparent object replication service connecting Kodiak Data clouds to public clouds like Amazon Web Services (AWS). EdgeCache tiers S3 objects inside Kodiak Data MemCloud™ for high-speed, local access. Software stacks such as HDFS, Elasticsearch, Druid, and Spark running in MemCloud can now access S3 objects at speeds exceeding 10Gbps, significantly reducing processing time and cost.

Kyvos 4.0 Unleashes the Value of Big Data for Qlik




Kyvos Insights, a big data analytics company, today announced that Kyvos 4.0, the new, groundbreaking version of the massively scalable, self-service analytics solution, has been validated by Qlik®, a leader in data analytics, as an optimized partner technology solution.



# *What is your responsibility regarding ethics?*

Writing policies  
Enforcing policies  
Writing code  
Publishing / communicating results



Decision-  
making





## What Went Wrong?

InBloom did not lack talent, resources, or great ideas, but throughout its brief history, the organization and the product seemed to embody contradictory business models, software development approaches, philosophies, and cultures. There was a clash between Silicon Valley-style agile software development methods and the slower moving, more risk-averse approaches of states and school districts. At times, it was as though a team of brilliant thinkers had harvested every “best practice” or innovative idea in technology, business, and education—but failed to whittle them down to a manageable and cohesive strategy. Despite the Gates Foundation’s ongoing national involvement with schools, the inBloom initiative seemed to not anticipate the multiple layers of politics and bureaucracy within the school system. Instead there were expectations that educational reform would be easily accomplished, with immediate results, or that – worst case – there would be an opportunity to simply fail fast and iterate.

However, the development of inBloom was large-scale and public, leaving little room to iterate or quietly build a base of case studies to communicate its value and vision. Thus, when vocal opposition raised concerns about student data use potentially harming children’s future prospects or being sold to third parties for targeted advertising, the initiative was caught without a strong counter-position. As opposition

## *Foundations for Ethical Decisions/ Stances?*

*What is the source of your beliefs  
in such cases?*

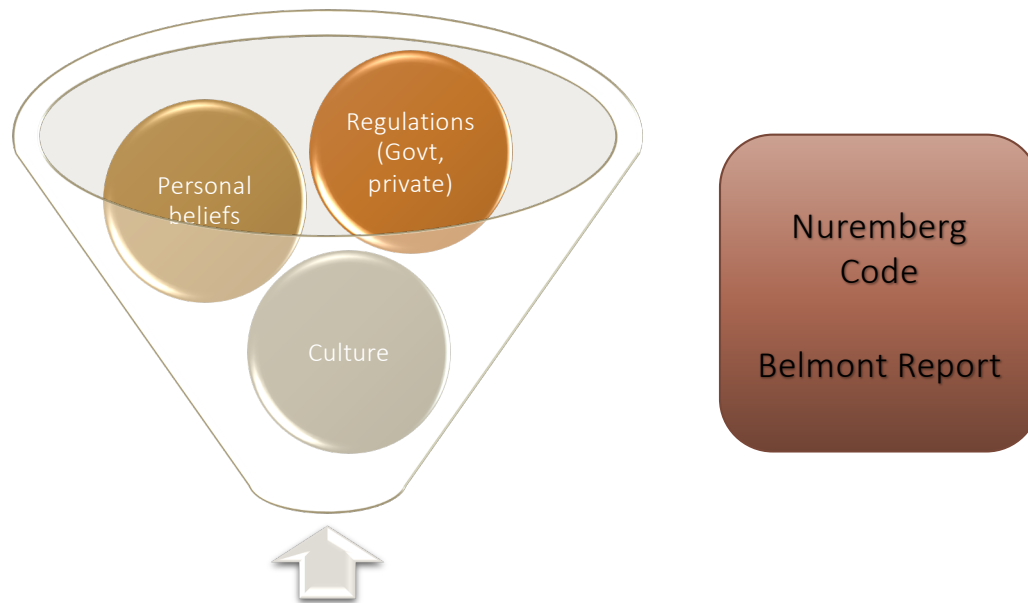
Ethical standards

Religious beliefs

Organizational  
Goals

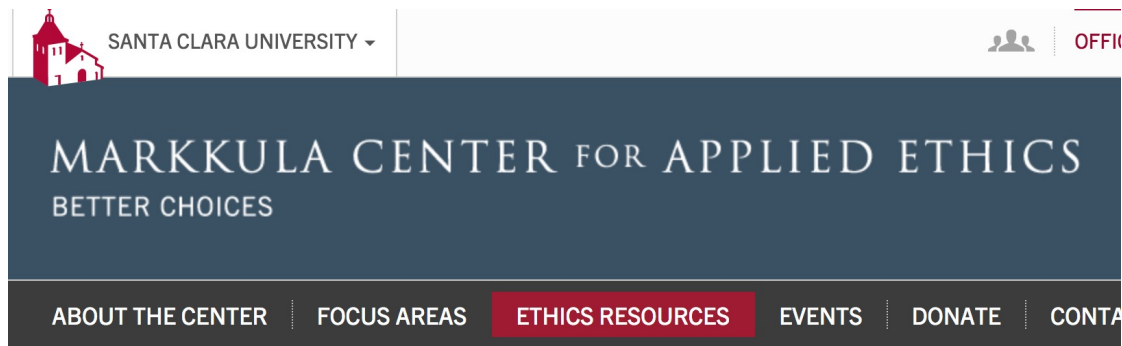
Past experience

## *Foundations for Ethical Decisions/ Stances?*



Ethical Codes / Frameworks /Standards

## *Ethical Codes*



## A Framework for Ethical Decision Making

---

## *Contemporary Ethical Codes*

respect for persons (autonomy, privacy, informed consent)  
balancing of risk to individuals with benefit to society  
careful selection of participants  
independent review of research proposals  
self-regulating communities of professionals  
funding dependent on adherence to ethical standards

Metcalf, Jacob. 2018. "Ethics Codes: History, Context, and Challenges." *Council for Big Data, Ethics, and Society*. Accessed April 16, 2018.  
<https://bdes.datasociety.net/council-output/ethics-codes-history-context-and-challenges/>.

## *Wrap up ...*

Evolving field

Ambiguous situations

Policies, regulations and frameworks can help

And.... Much will probably be decided in the judicial system

