

# Distributed Algorithms

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# Distributed Algorithms

- Distributed algorithms have wide-ranging applications
  - Cloud computing
  - Machine learning
  - Social networks
  - Swarm robotics
  - Multi-core processors
  - Supercomputing
  - ...

# My Current Research

- Distributed optimization and learning: Security & Privacy
- Consistency of key-value stores
- Distributed consensus
- Graph algorithms

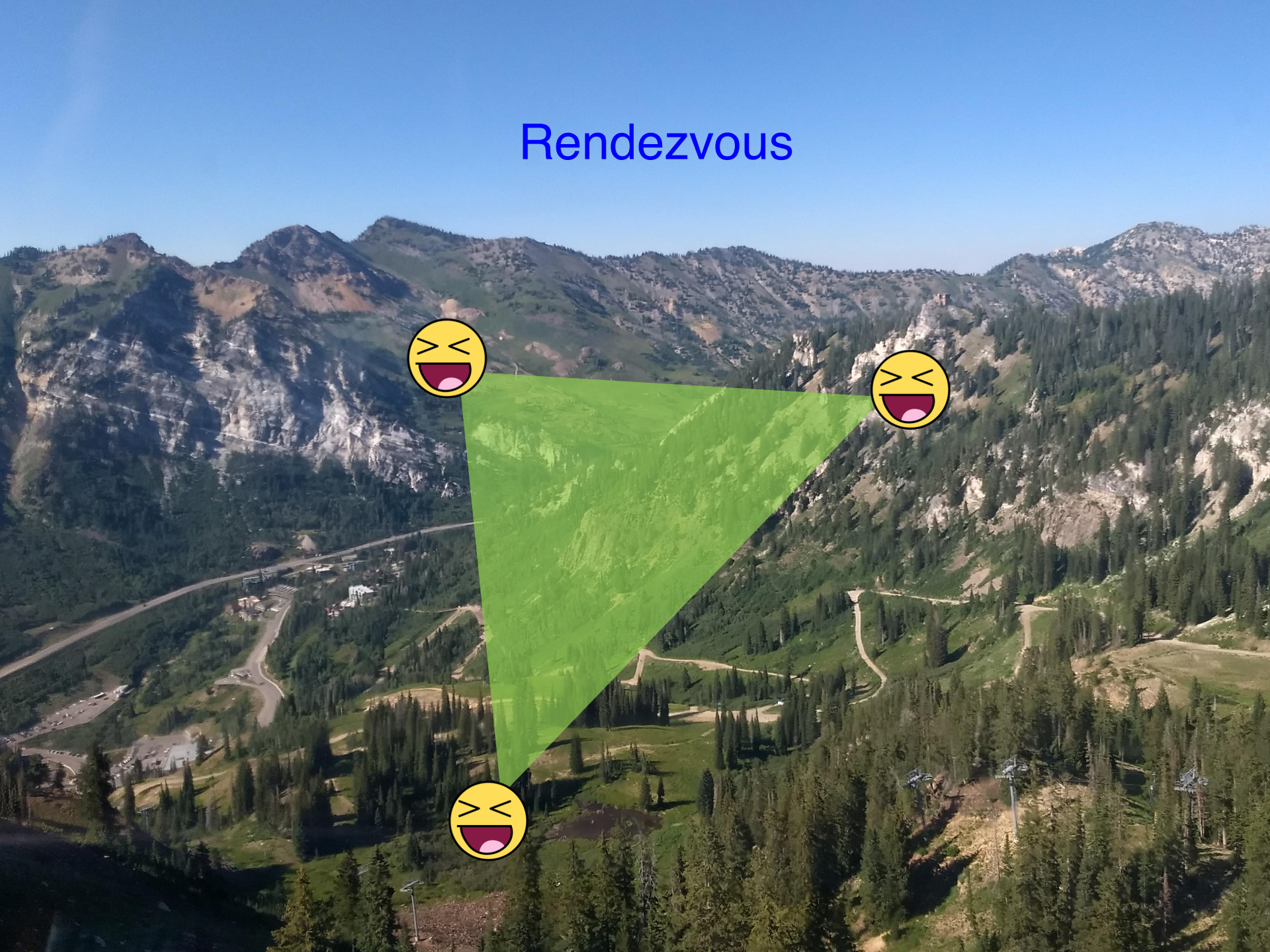
# Security and Privacy for Distributed Optimization and Learning

# Security and Privacy for Distributed Optimization and Learning

Tutorial posted starting this week

<https://disc.georgetown.domains> → Talks

# Rendezvous



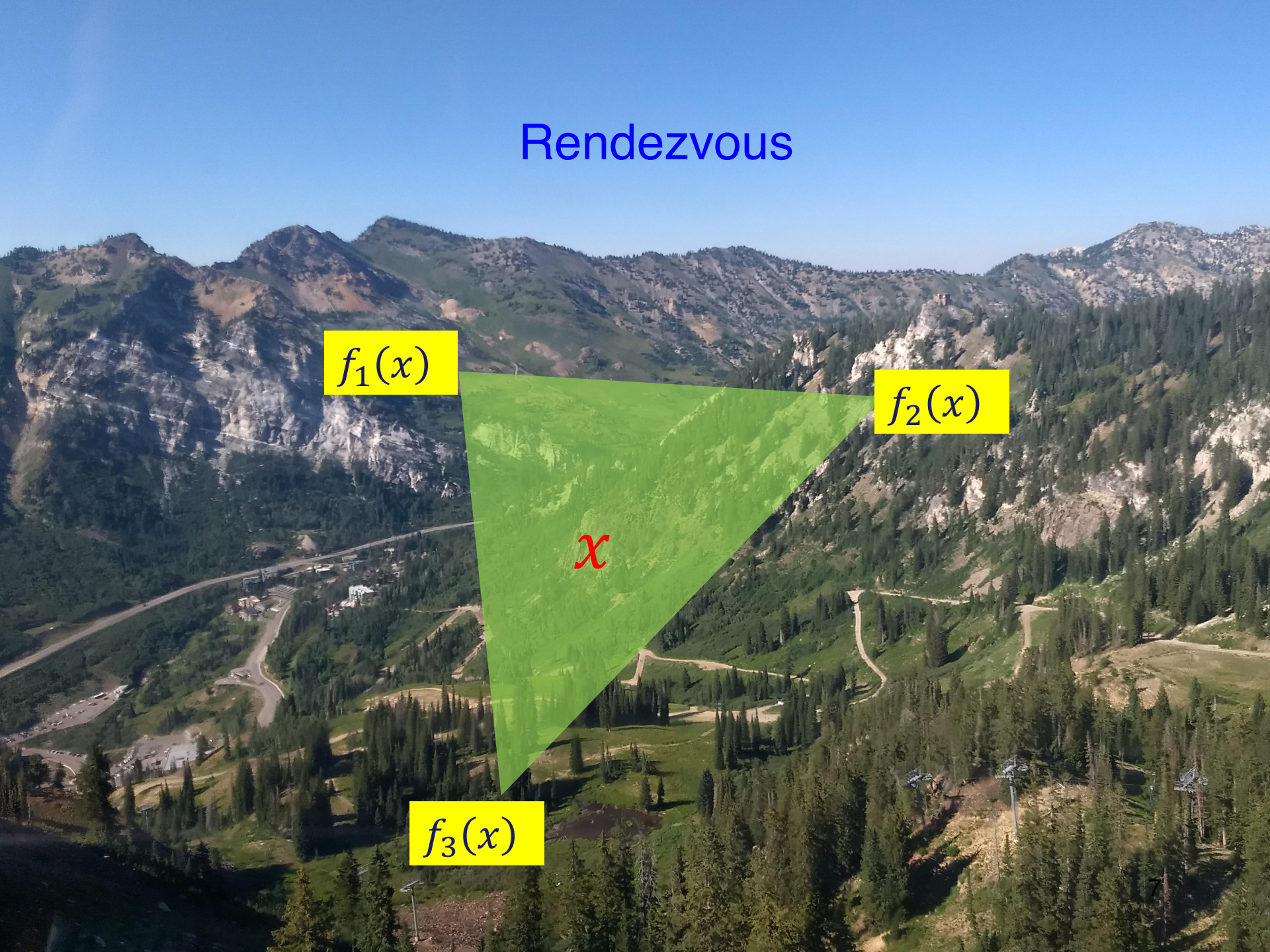
# Rendezvous

$f_1(x)$

$f_2(x)$

$x$

$f_3(x)$



# Rendezvous

$f_1(x)$

$f_2(x)$

$x$

$f_3(x)$

minimize  $\sum f_i(x)$



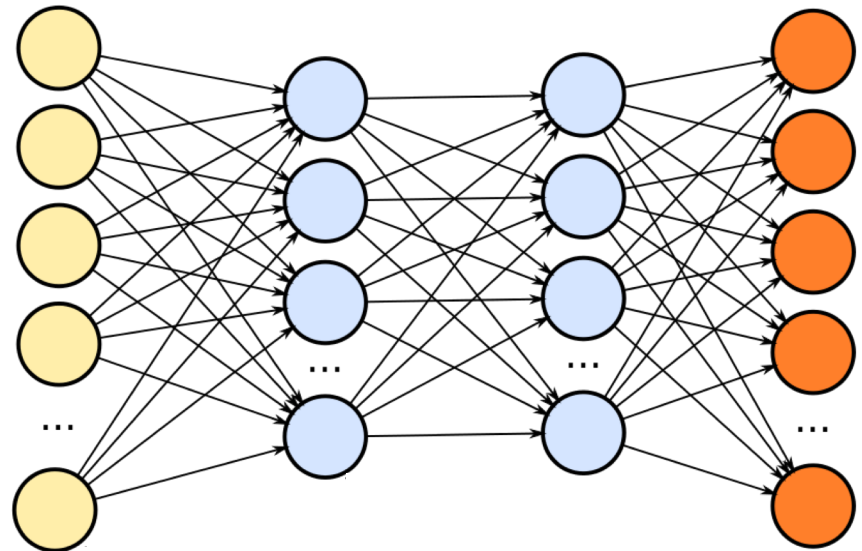
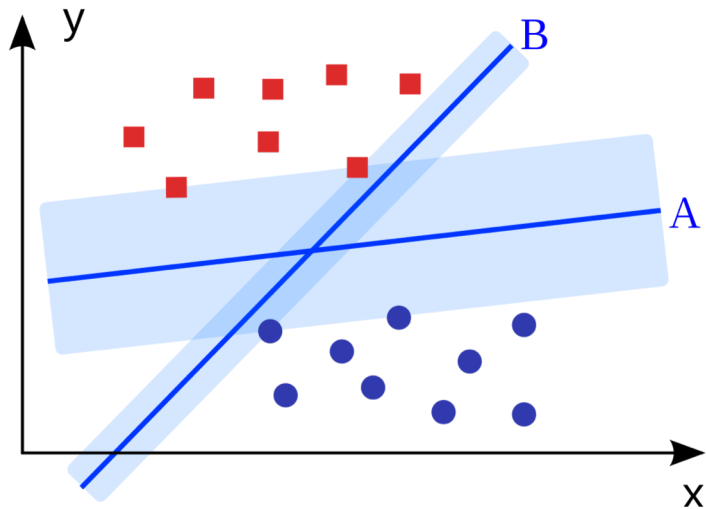
# Machine Learning

- Data is distributed across different agents



- Data is distributed across different agents

➔ Collaborate to learn



# Machine Learning



Minimize  
global loss

$$\sum f_i(x)$$

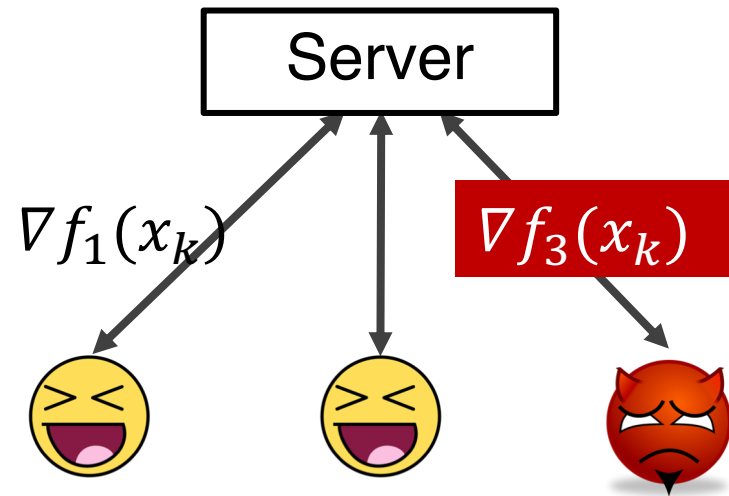
# Challenges

# Challenge #1

- **Fault-tolerant (secure)**  
distributed optimization

$$f_1(x) + f_2(x) + f_3(x)$$

How to optimize  
if agents inject  
bogus information?



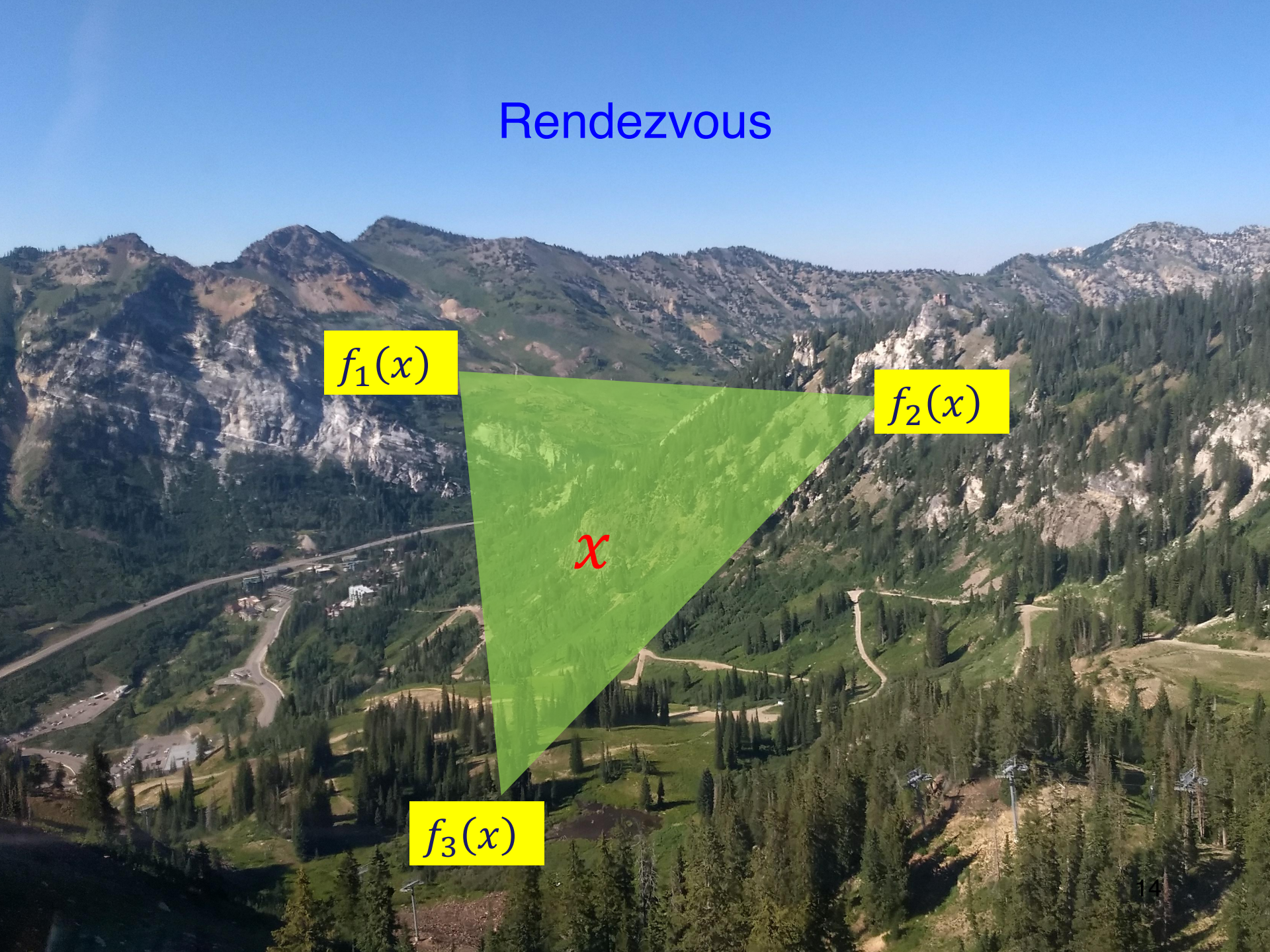
# Rendezvous

$f_1(x)$

$f_2(x)$

$x$

$f_3(x)$



# Rendezvous

$f_1(x)$

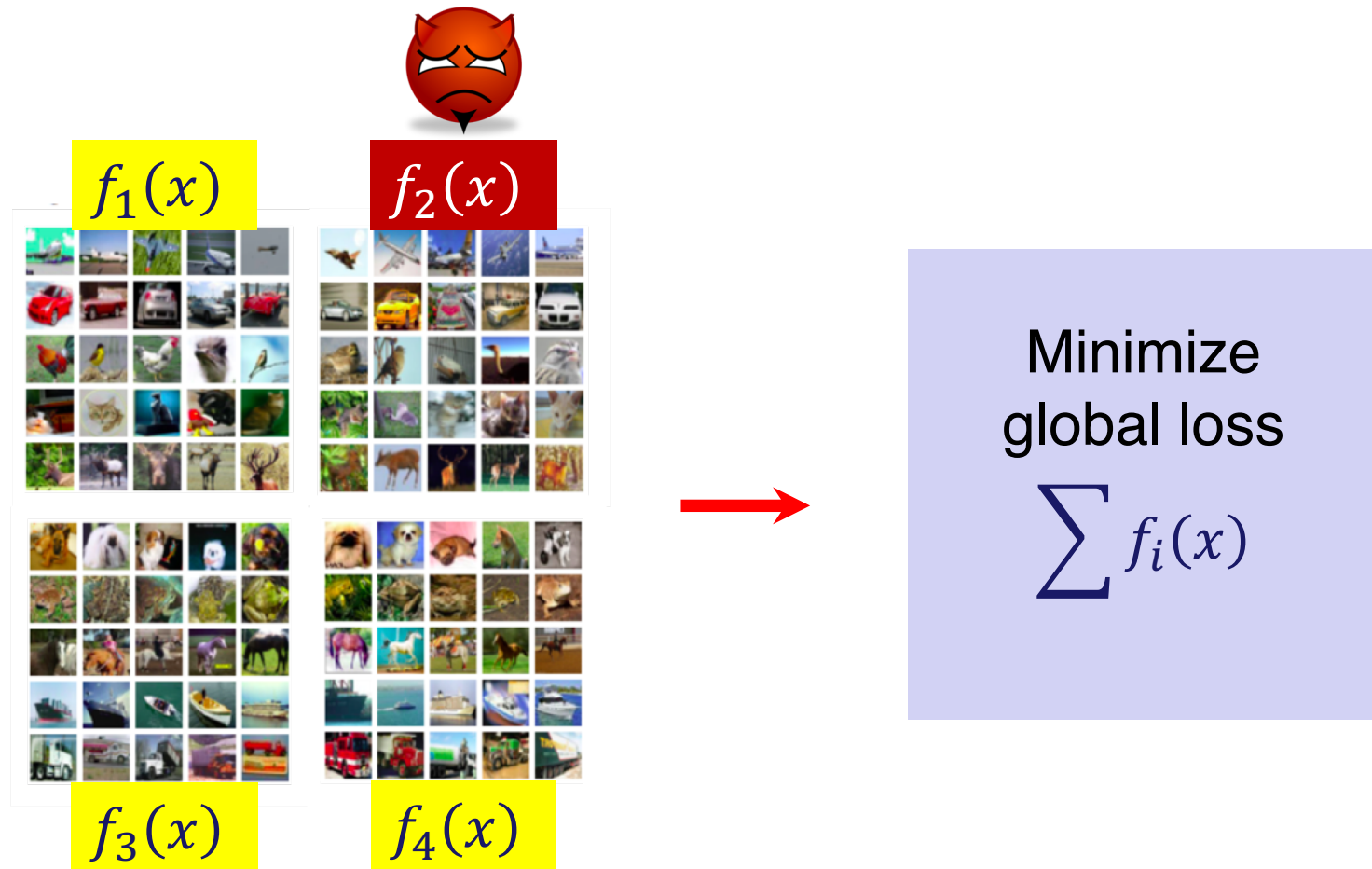
$f_2(x)$

$x$



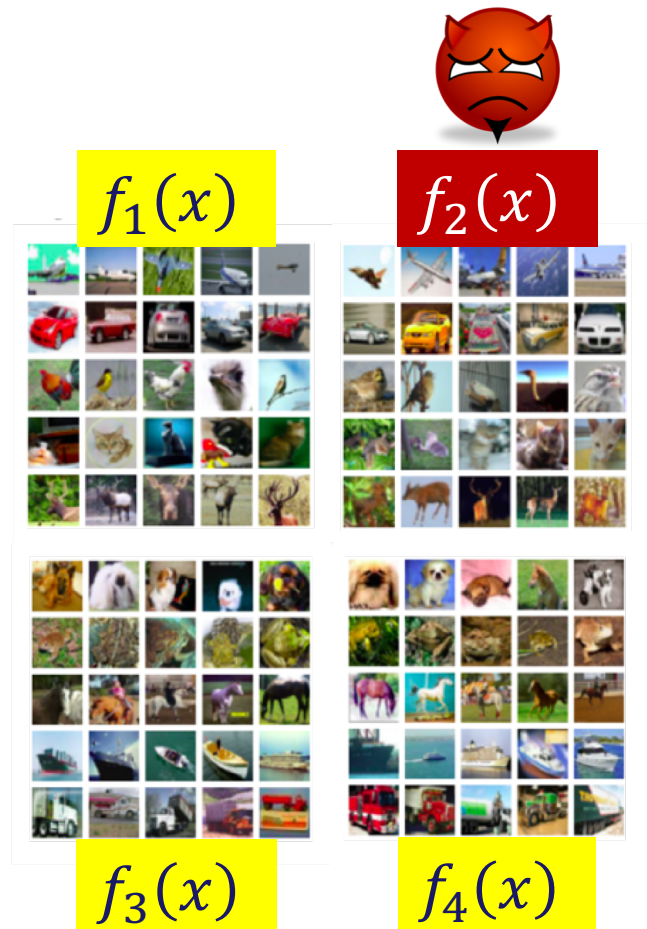
$f_3(x)$

# Machine Learning





# Machine Learning



Faulty agents can adversely affect model parameters

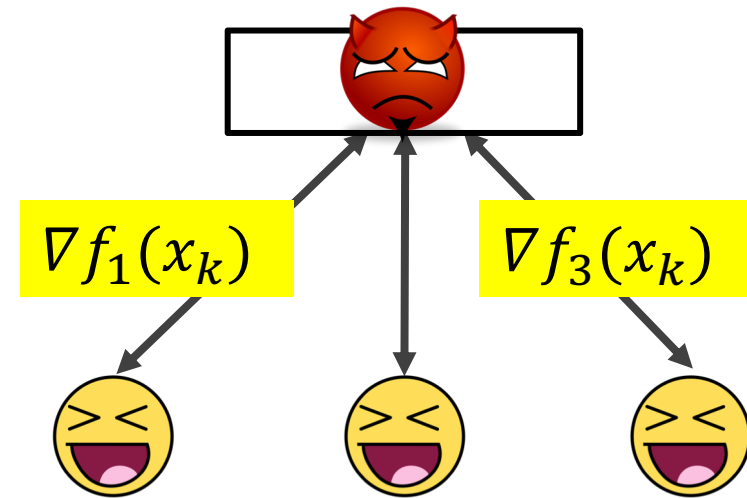
Minimize global loss

$$\sum f_i(x)$$

## Challenge #2

- Privacy-preserving distributed optimization

How to collaborate without revealing own cost function?



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For More Information

<https://disc.georgetown.domains>