My Smartphone Knows I am Hungry

Fanglin Chen, Rui Wang, Xia Zhou , Andrew T. Campbell

Dartmouth College

Logging by Input

https://jawbone.com/up

Use Devices to Track Eating

HapiFork
http://www.hapi.com/products-hapifork.asp

Use Devices to Track Eating

Yatani et al. BodyScope Ubicomp 2012

Rahman et al. BodyBeat, MobiSys 2014

Need Specialized Hardware

Photo:gtresearchnews.gatech.edu

Can your smartphone **unobtrusively** predict your food eating behavior?

Can your smartphone **unobtrusively** predict your food ~~eating behavior~~?

purchases

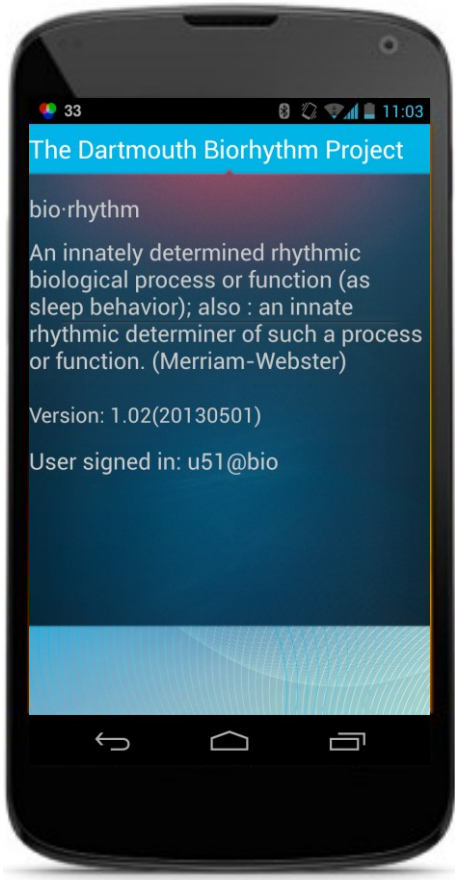
Our Work

unobtrusively collect behavior data

build predictive model

predict buy food or not

Dataset – Evidence



- 25 students, 10 weeks
- Smartphone app runs 24/7 in the background to collect:
  - Conversation
  - Physical activity
  - Sleep
  - Location
  - Bluetooth colocation
  - Wi-Fi scan log

Dataset – Ground Truth

- We collected dinning records
  - Purchase time
  - Location
  - Account
  - Cost
- **We don't know what they bought**

Purchase Time	Location	Account	Type	Cost
04/11/2013 01:57:26	Novack Cafe	Dining DBA	Debit	$3.55
04/11/2013 10:10:31	Collis Cafe	Dining DBA	Debit	$7.45

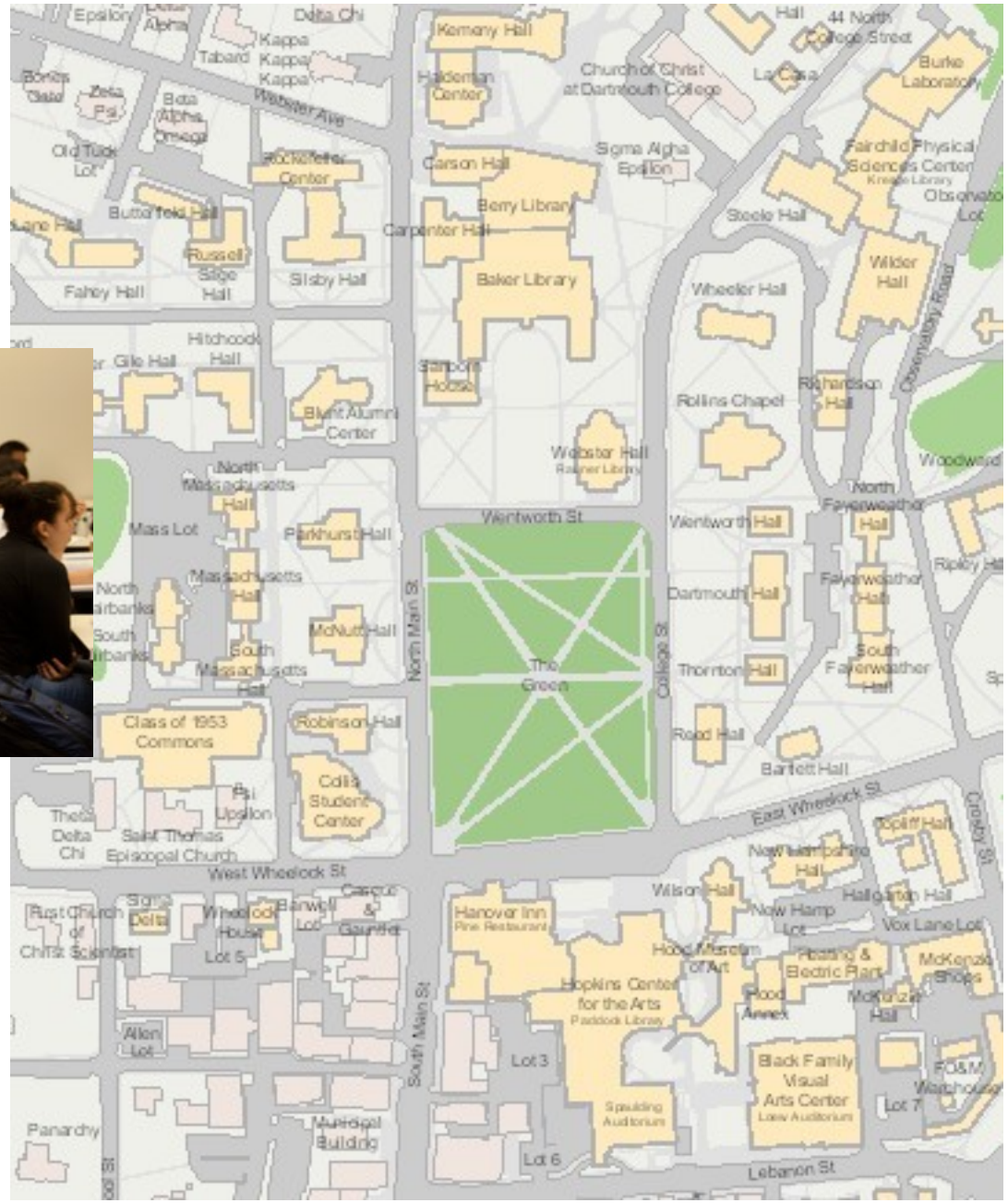
Roadmap

- Motivation
- **Design Challenges**
- Approach
- Results
- Conclusion

Why Not Just Use Location?

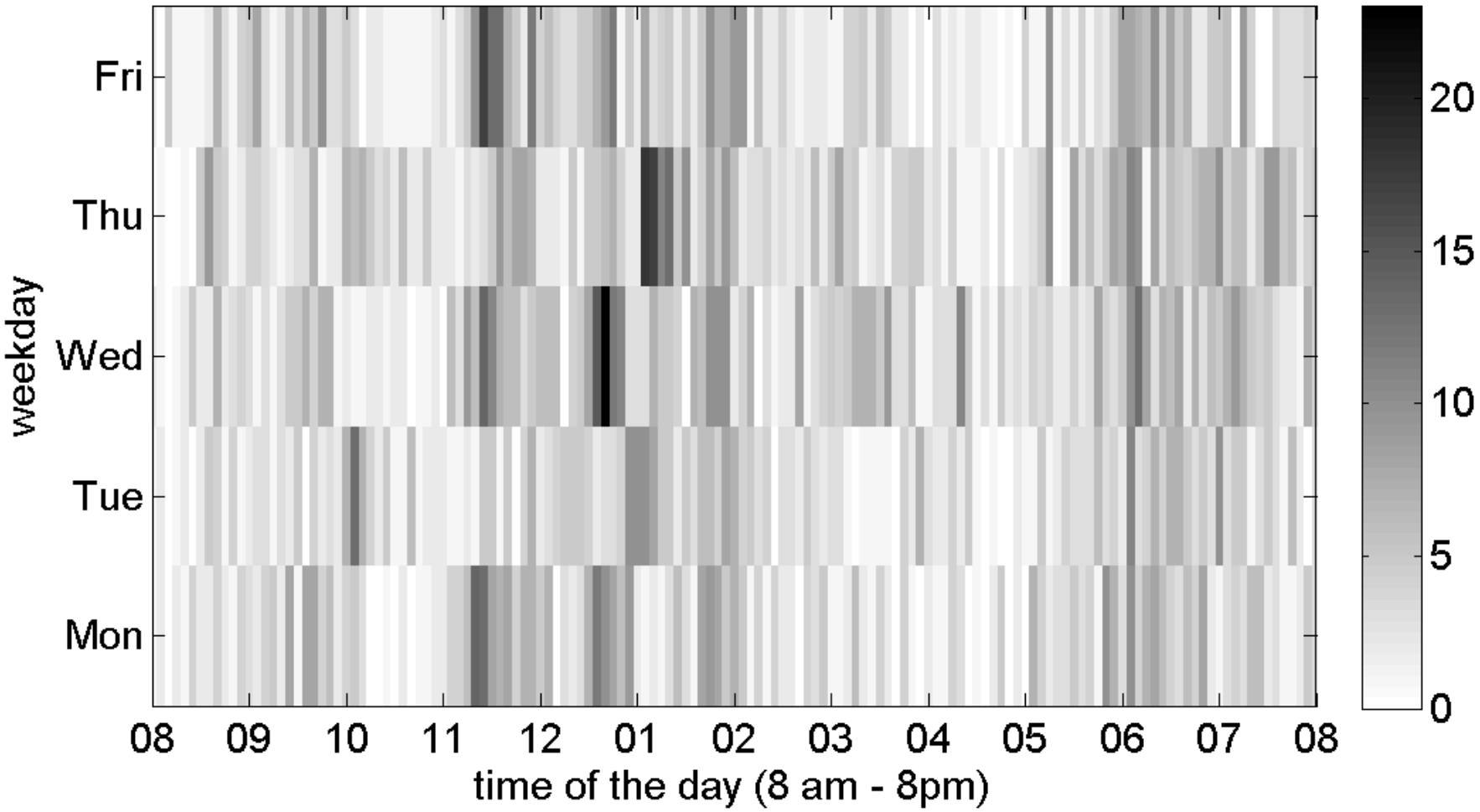

McDonald's
i'm lovin' it

Not the Case for Campus



Why Not Use Time?

No Distinct Mealtimes



Roadmap

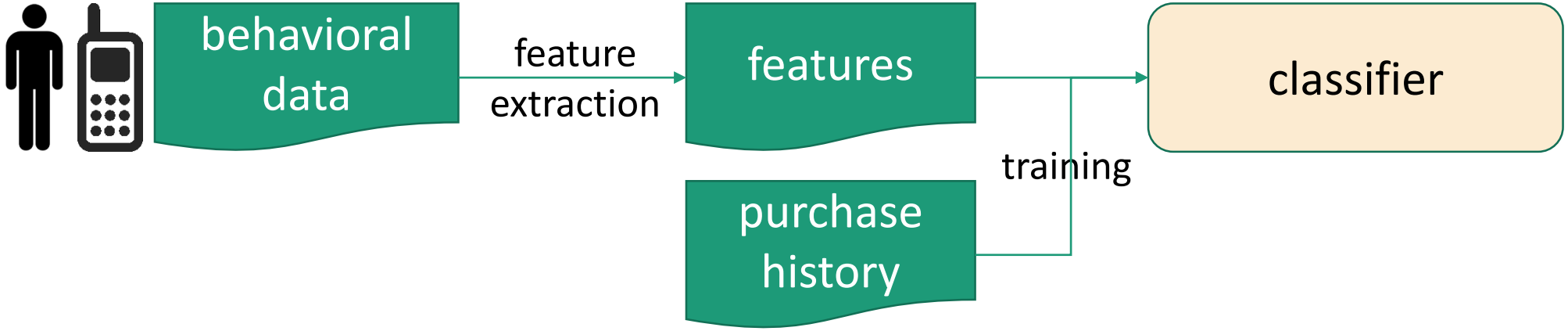
- Motivation
- Design Challenges
- **Our approach**
- Results
- Conclusion

Our Approach

- Unobtrusively monitor user behavior
- Identify food purchasing related behaviors
- Build a predictive model

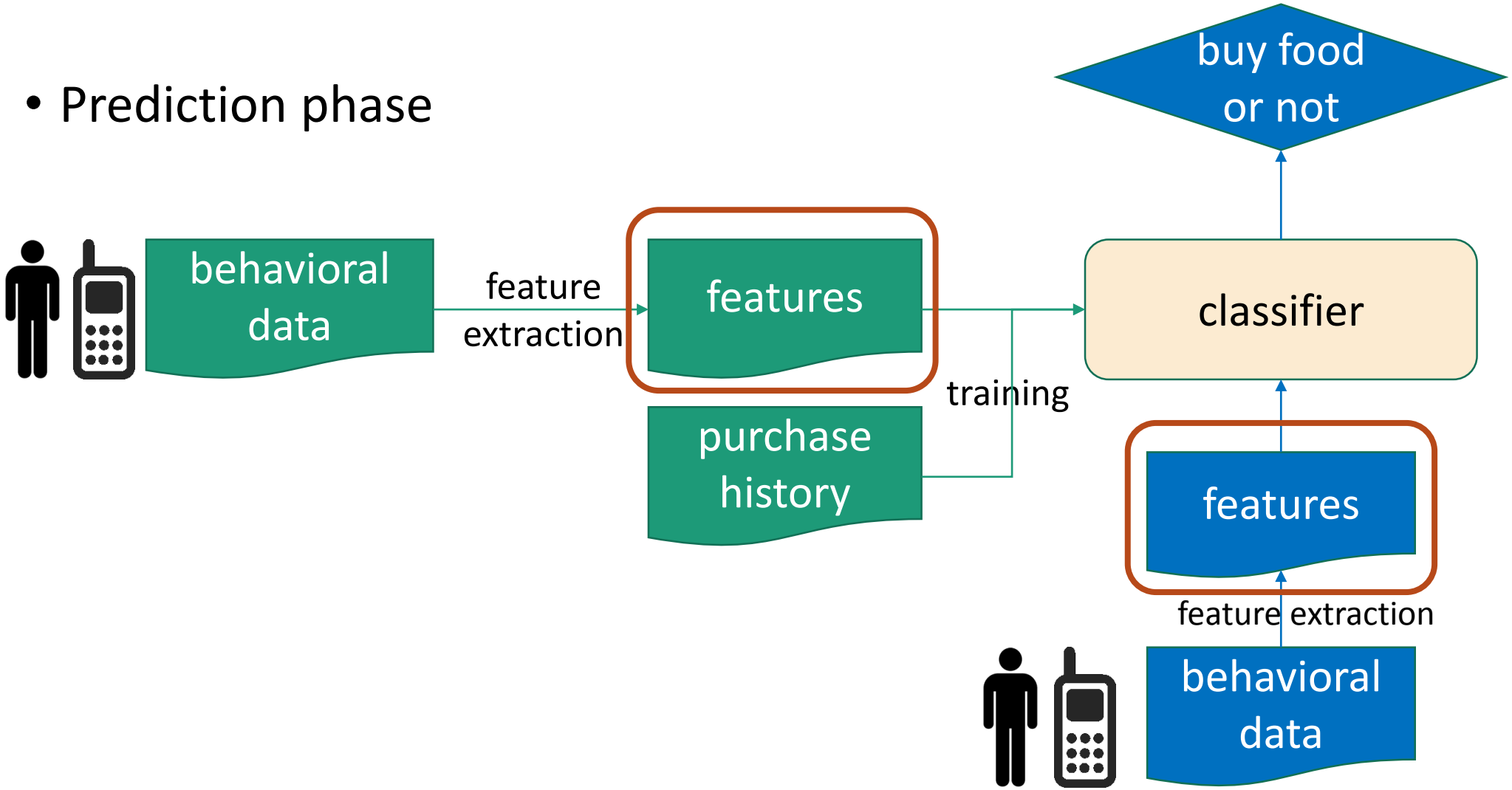
Prediction Pipeline

- Training phase



Prediction Pipeline

- Prediction phase



Features Related to Food Purchase

Previous Location



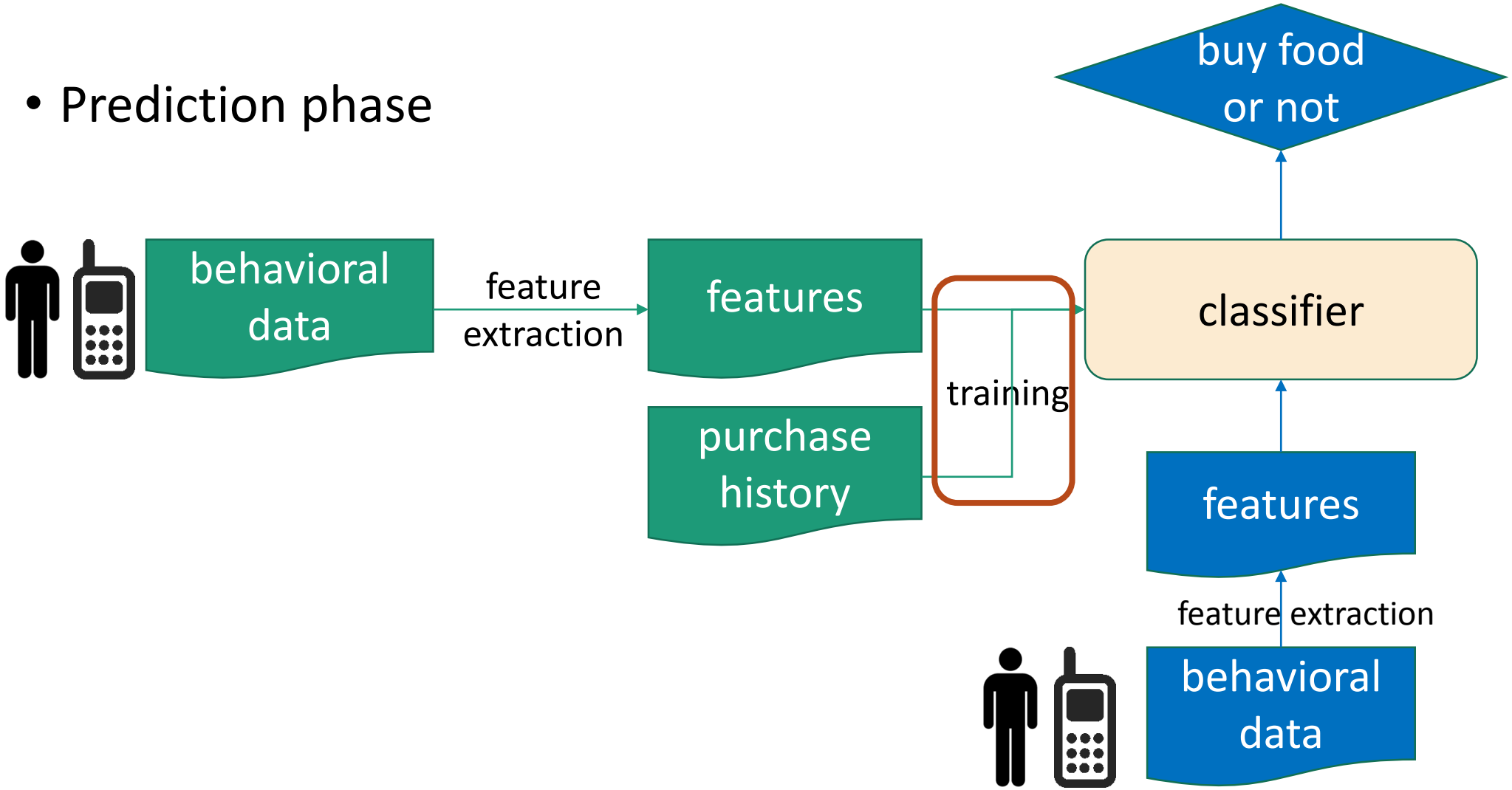

- Location
- Arrival time / Leaving time
- Conversation
- Physical activity

Current Location


- Location
- Arrival time

Prediction Pipeline

- Prediction phase



Approach: Training Set Selection

- Select training data based on **personalization** and **adaptation.**

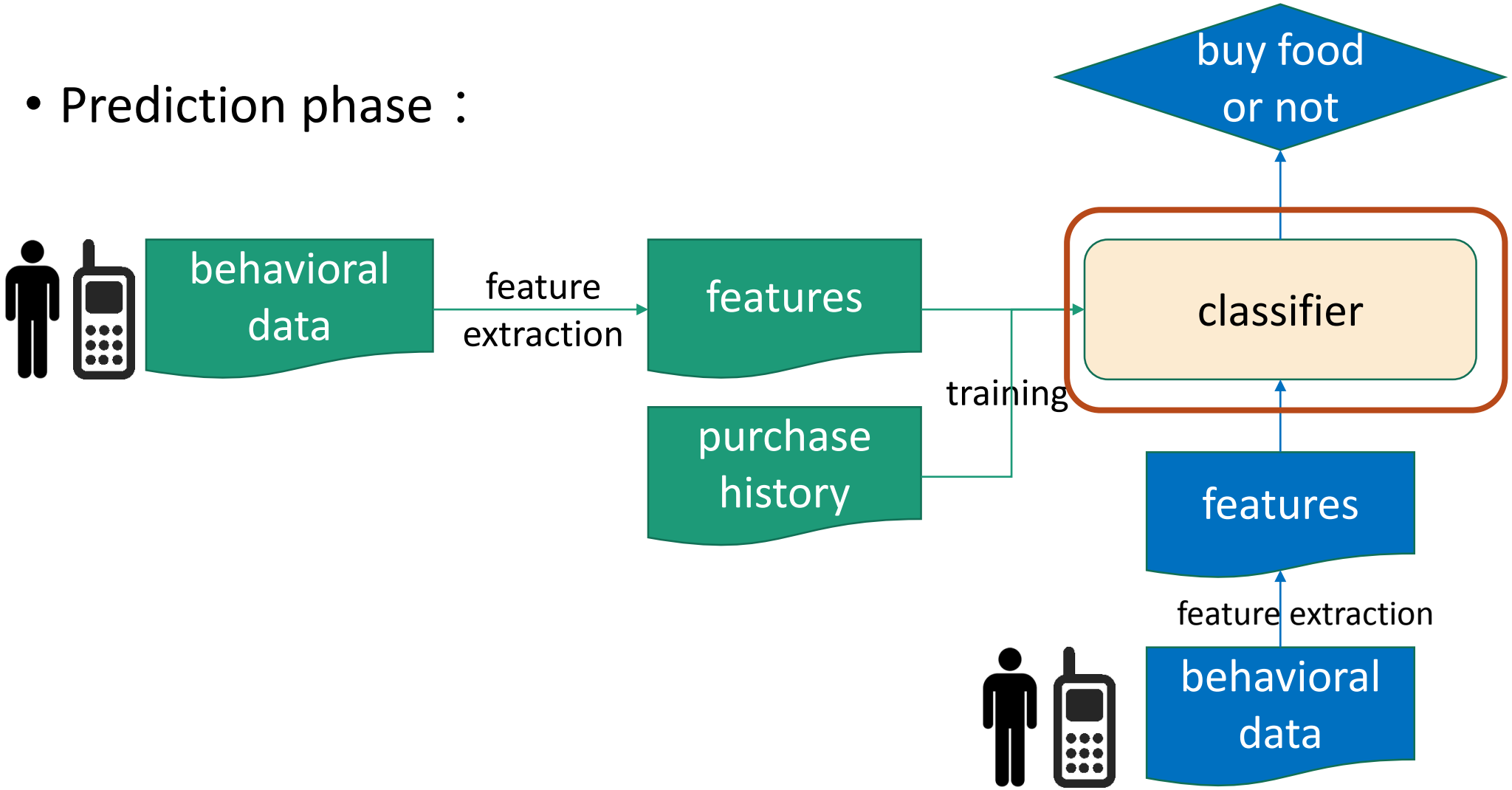
One size does not fit all.

Behavior changes over time.

Use latest n weeks data to train

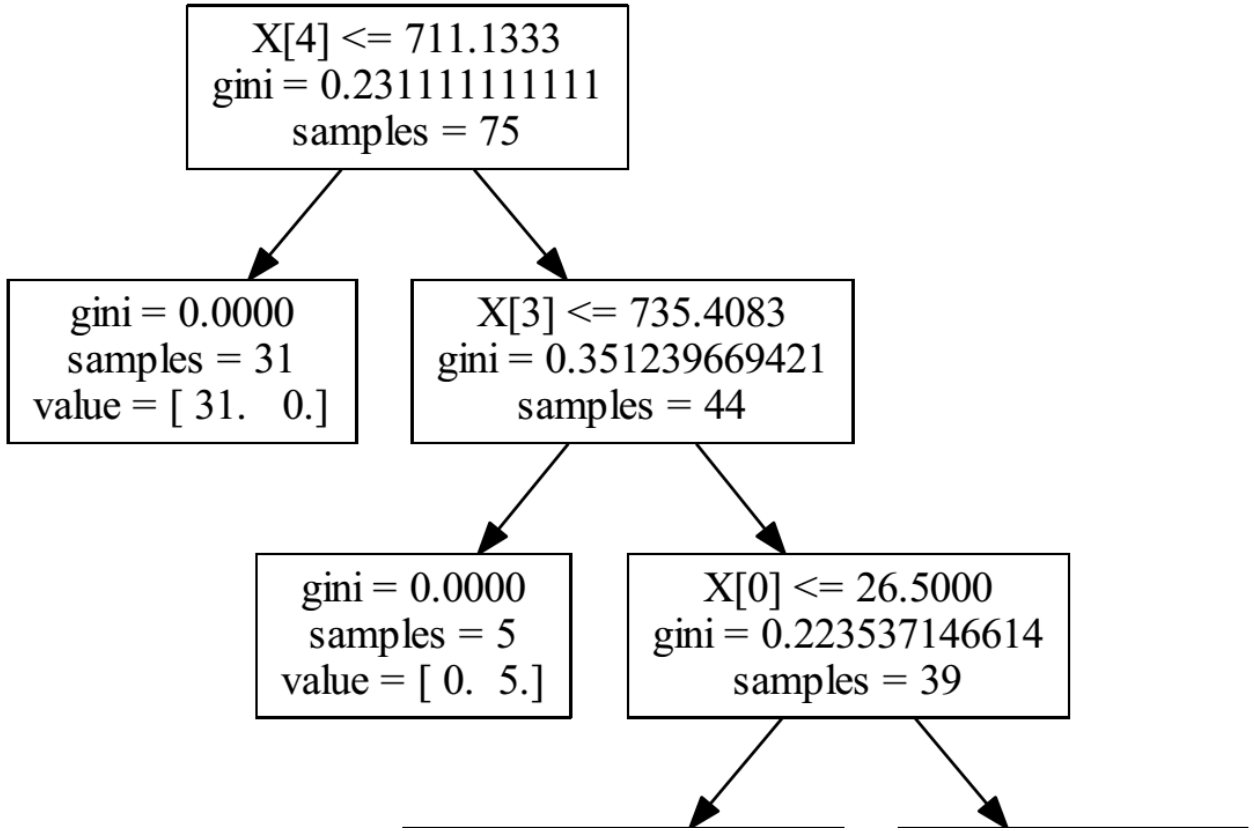
Prediction Pipeline

- Prediction phase：



Approach: Classifier

- Classification and Regression Trees (CART)
- Handles categorical data (location) and numerical data (behavioral)



decision tree

Roadmap

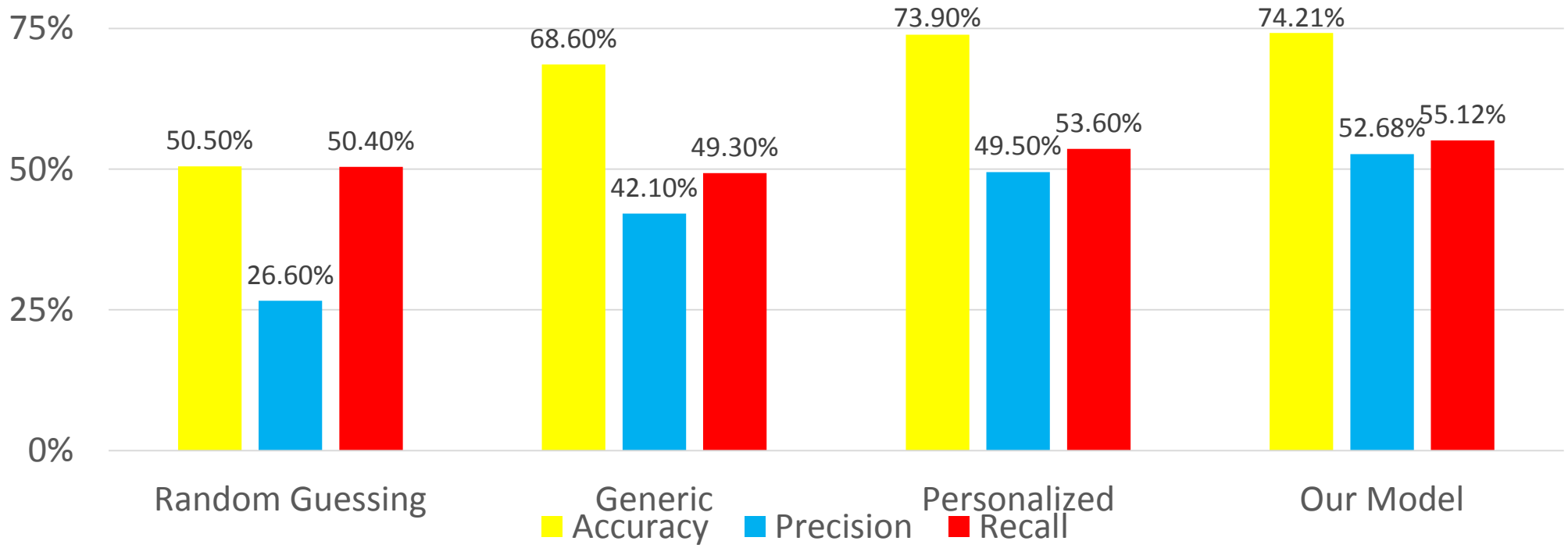
- Motivation
- Design Challenges
- Approach
- **Results**
- Conclusion

Evaluation Setup

- Schemes for comparison
  - Random guessing: flip a coin
  - Generic: one size fits all model
  - Personalized: personalized model but without adaptation
  - Our model: personalization and adaptation

- Metrics
  - **Accuracy**: % of correct predictions
  - **Precision**: % of correct predictions in all positive predictions
  - **Recall**: % of identified real true cases

Key Result



- Random guessing < generic < personalized < our model (personalized and adapted)

Roadmap

- Motivation
- Design Challenges
- Approach
- Results
- **Conclusion**

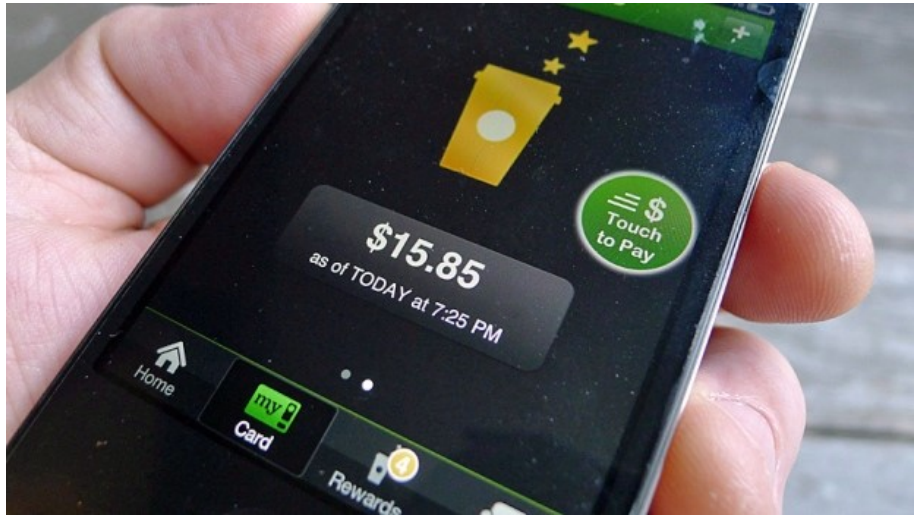
Conclusion and Limitation

- Proposed a simple predictive model of food purchases
  - **74%** accuracy using smartphone sensing data

- Limitations
  - Cannot predict what food student would buy
  - Do not cover food purchases beyond student ID card
  - Do not know when they ate their food
  - Limited to student body

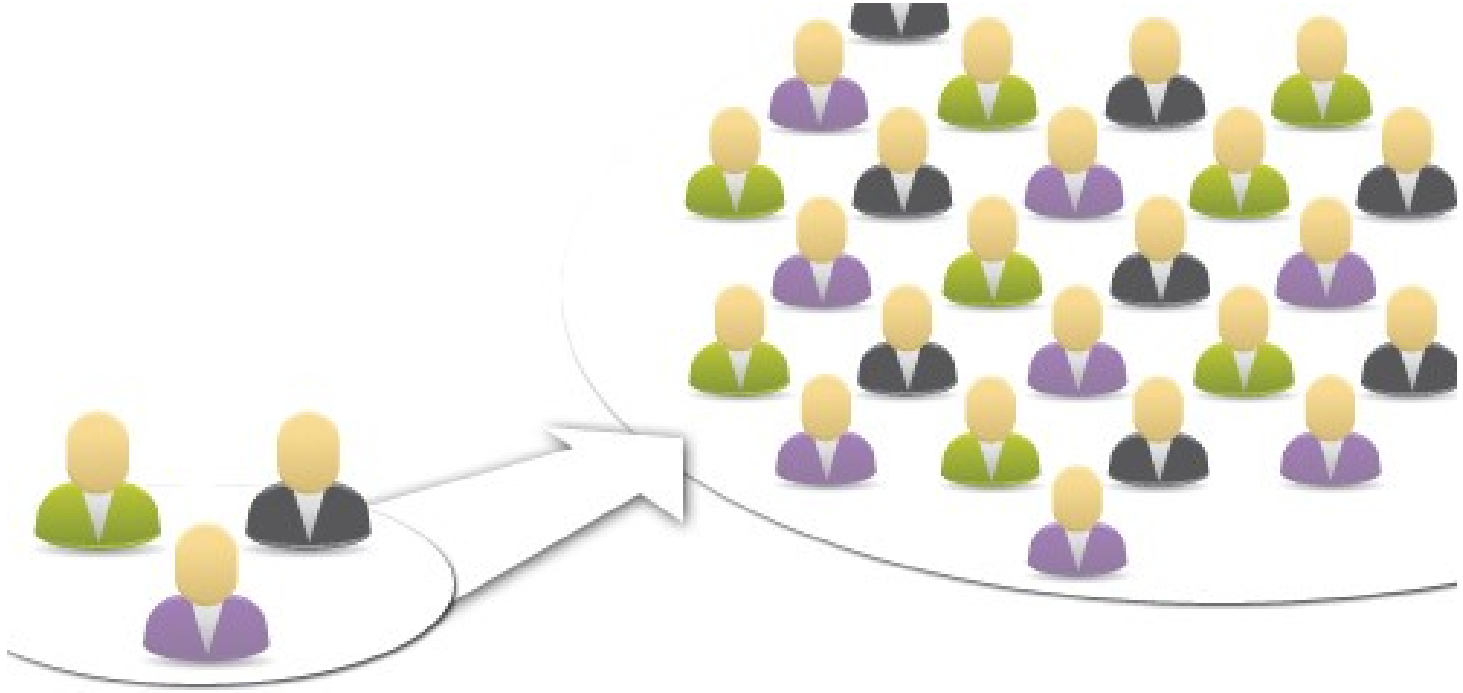
Future Work

- How can we unobtrusively track what we bought?



Future Work

- How to generalize the model?

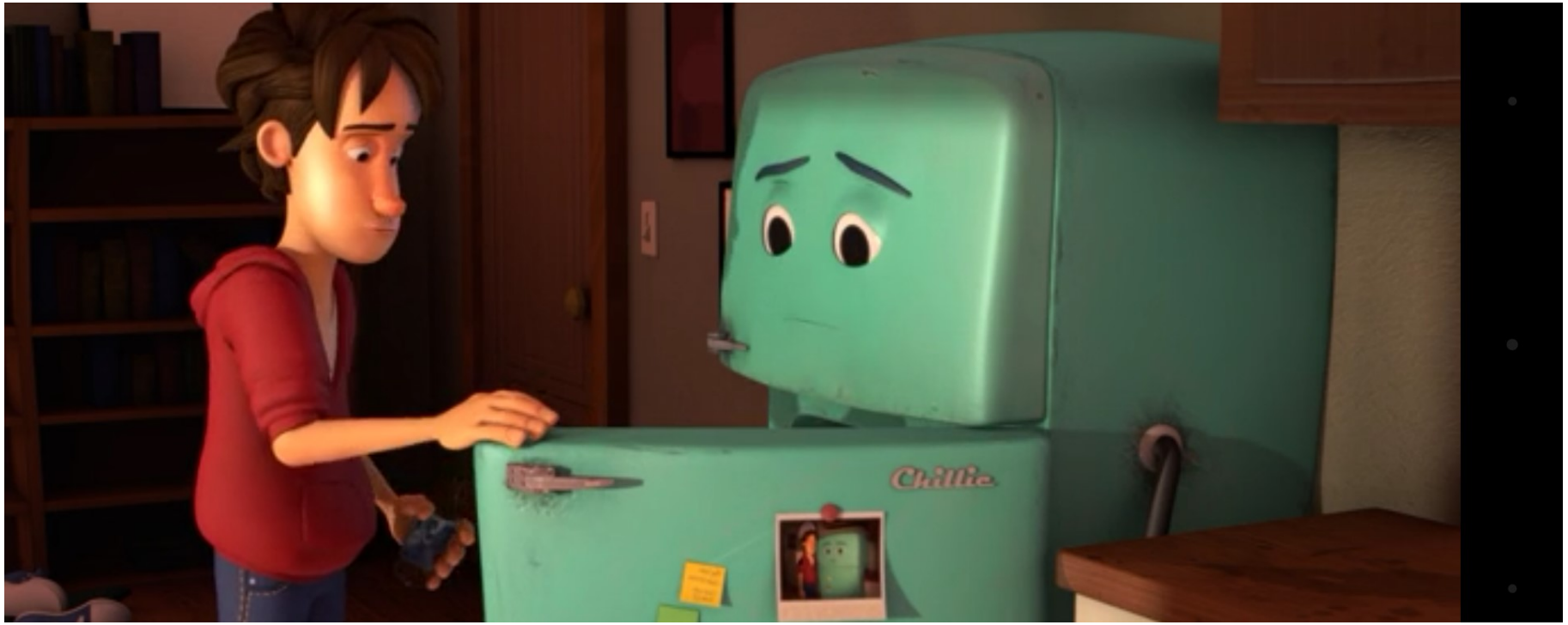


Future Work

- How to unobtrusively detect eating?

Future Work

- Food intervention



Thanks!

Backup

What Features are more predictive