
## Unique Personalities

# This is a programmer talk

- Quite technical
- Not super-technical
- Lots of movies

# Two Big Goals

- Simulate a larger varied living world
- Make unique Sims

# Emergent Narrative

- Why those two goals?
- These two goals serve the wider goal, of having a system which enables *emergent narrative*

# Emergent Narrative: Alice and Kev

- A blog about a pair of homeless Sims
- Author: Robin Burkinshaw

# Alice and Kev

- “A surprising amount of the interesting things in this story were generated by just letting go and watching the Sims’ free will and personality traits take over"

# Alice and Kev

- Kev, the father, is mean-spirited and highly inappropriate

# Alice and Kev

- Alice, his daughter, is sweet, kind, forgiving

# Emergent Narrative

- Kev needs somewhere to stay
- People invite him in, but his inappropriate behavior causes them to chuck him out
- Eventually, Kev even alienates his own daughter

- Goal: Emergent narrative
- Subgoal: simulate a larger varied living world
- Subgoal: make unique Sims

# Two Big Goals

- **Simulate a larger varied living world**
- Make unique Sims

# Simulating a Larger World

- > Movie 1

# Simulating a Larger World

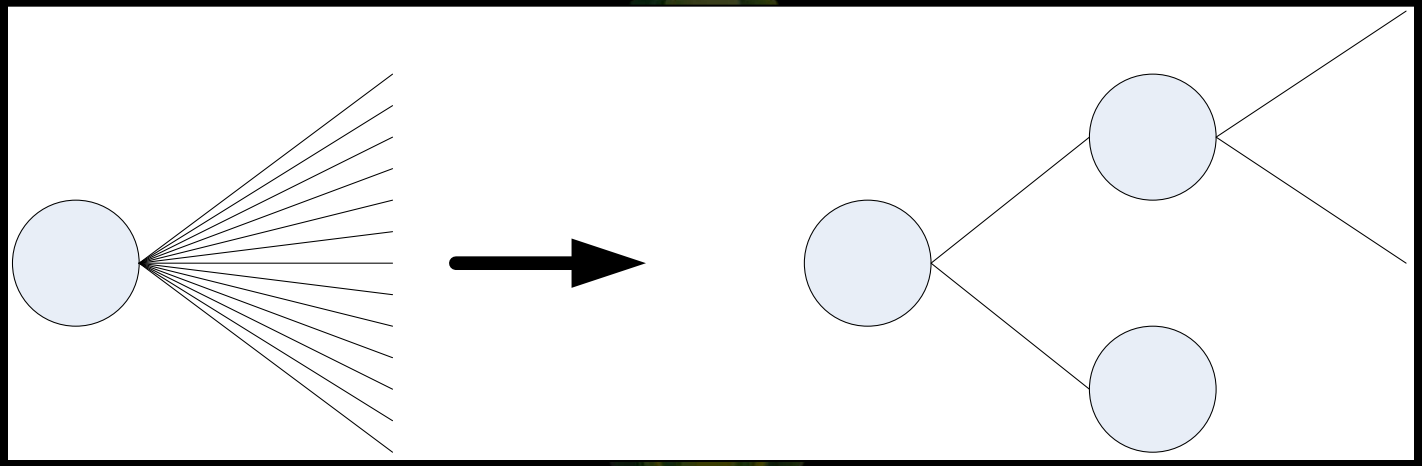
- Hierarchical Planning
- Commodity-Interaction maps
- Auto-satisfy curves
- Story-progression

# Simulating a Larger World

- **Hierarchical Planning**
- Commodity-Interaction maps
- Auto-satisfy curves
- Story-progression

# Hierarchical Planning

- The aim is to reduce the branching factor:



# Hierarchical Planning

- Bad idea:

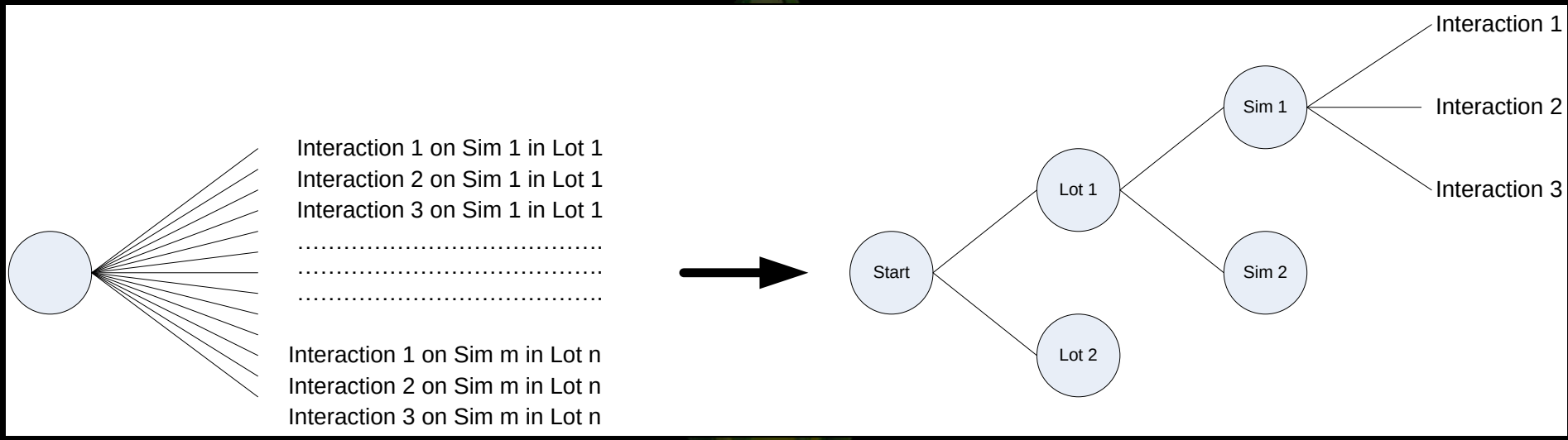
```
for each lot l
   for each agent x in l
         for each social interaction a on x
               consider performing a on x
```

- Better idea:

```
Choose which lot to go to: l
Then choose which agent to talk to in l : x
Then choose which social interaction to perform
```

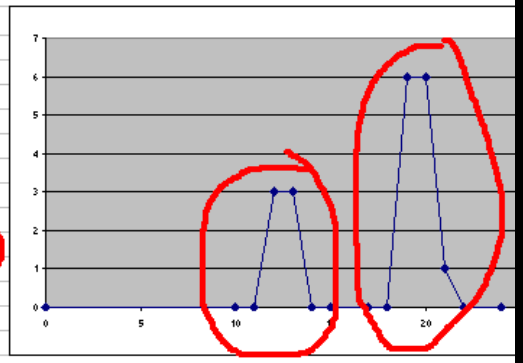
- O(L * M * N) vs O(L + M + N)
- L is the number of lots, M is the number of agents, and N is the number of interactions on each agent
- L = 90, M = 80, N = 300

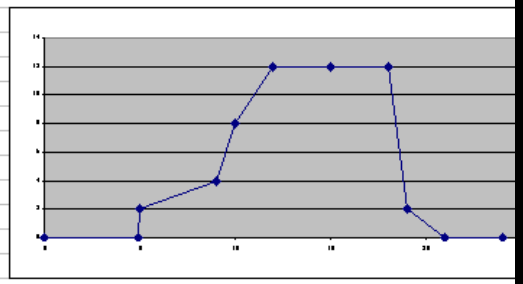
# Hierarchical Planning

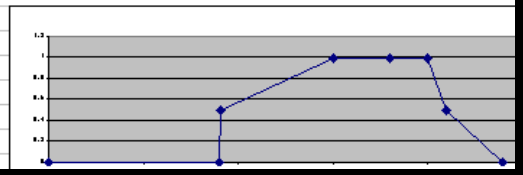


# Hierarchical Planning: Lots have motives too!

| Venue | OneShotMotives | Encoura | Excludin | Encoura | Encoura | Time | NumDe | NumDesiredSimsWhenActiveActorIsAround |
|---|---|---|---|---|---|---|---|---|
| | | | | | | -1 | -1 | -1 |
| **Restaurant** | EatOutside | NaturalC | Frugal | Culinary | Cooking | | | |
| | | | | | | 0 | 0 | 0 |
| | | | | | | 10 | 0 | 0 |
| | | | | | | 11 | 0 | 0 |
| h | | | | | | 12 | 3 | 7 |
| h | | | | | | 13 | 3 | 8 |
| h | | | | | | 14 | 0 | 0 |
| | | | | | | 15 | 0 | 0 |
| | | | | | | 17 | 0 | 0 |
| | | | | | | 18 | 0 | 3 |
| er | | | | | | 19 | 6 | 8 |
| er | | | | | | 20 | 6 | 8 |
| | | | | | | 21 | 1 | 3 |
| | | | | | | 22 | 0 | 0 |
| | | | | | | 24 | 0 | 0 |
| | | | | | | | | |
| | | | | | | | | |
| **BigPark** | Social, StayAtVenue, Fun | LovesTh | HatesOut | Professio | Athletic | | | |
| | | | | | | 0 | 0 | 0 |
| | | | | | | 4.9 | 0 | 0 |
| | | | | | | 5 | 2 | 2 |
| | | | | | | 9 | 4 | 6 |
| | | | | | | 10 | 8 | 15 |
| | | | | | | 12 | 12 | 15 |
| | | | | | | 15 | 12 | 15 |
| | | | | | | 18 | 12 | 15 |
| | | | | | | 19 | 2 | 8 |
| | | | | | | 21 | 0 | 2 |
| | | | | | | 24 | 0 | 0 |
| | | | | | | | | |
| **SmallShop** | StayAtVenue | Snob | | PTBookstoreClerk, PTGroceryStoreClerk | | | | |
| | | | | | | 0 | 0 | 0 |
| | | | | | | 9 | 0 | 0 |
| | | | | | | 9.1 | 0.5 | 2 |
| | | | | | | 15 | 1 | 4 |
| | | | | | | 18 | 1 | 4 |
| | | | | | | 20 | 1 | 4 |
| | | | | | | 21 | 0.5 | 2 |





# Simulating a Larger World

- Hierarchical Planning
- **Commodity-Interaction maps**
- Auto-satisfy curves
- Story-progression

# Commodity-Interaction Maps

- Sims 1 & 2:

```
for each interaction a on each object x
        check if a is currently available on x
        if so, work out how much I want to do a
```

- This is very inefficient when most desires are satisfied most of the time.
- Suppose I have just eaten a large meal, and am completely full up. The Sim will still consider every possible food interaction, even though he has no need to eat!
- In Sims 3, we store a map from things we might want ("commodities") to interactions which satisfy that commodity.

# Commodity-Interaction Maps

| Commodity | Interactions |
|---|---|
| Bladder | Use(ToiletStall) Use(ToiletStall) Use(ToiletStall) Use(ToiletStall) |
| Hunger | Have Refreshing Drink(BarModern) Have Refreshing Drink(BarModern) (FridgeDrawer) (FridgeDrawer) |
| Energy | Nap(ChairLivingDesigner) Nap(ChairLivingDesigner) Drink Delicious Half-Caf Chocolate Lite Frothiccino with Caramel Spri |
| Hygiene | Take Shower(ShowerLoft) Take Bath(BathtubModern) Take Delightful Bubble Bath(BathtubModern) Take Shower(Shower |
| Fun | Pump Iron(WorkoutBench) Dance(StereoExpensive) Turn On(StereoExpensive) Strength Training(StereoExpensive) Take |
| Dirtiness | Clean(C4) Clean(C6) Clean(ShowerLoft) Clean(BathtubModern) Clean(ToiletStall) Clean(ToiletStall) Take Out Trash(Trash |
| Social | Train (WorkoutBench) (WorkoutBench) Train (StereoExpensive) (StereoExpensive) Train Buster(TVWall) (TVWall) Train ( |
| ComeAndSee | Check Out New Object(Pool) |
| DaredevilOnDare | Take Shower(ShowerLoft) Take Shower(ShowerLoft) Take Shower(ShowerLoft) Take Shower(ShowerLoft) |
| ExtinguishSelf | Put Out Self(ShowerLoft) Put Out Self(ShowerLoft) Put Out Self(ShowerLoft) Put Out Self(ShowerLoft) ***** Gameplay/Abstract |
| SwimmingInPoolMotive | ***** Gameplay/Abstracts/ScriptObject/GetInPool:InteractionName *****(Pool) Swim(Pool) |
| PrepareForParty | Clean(C4) Clean(C6) Clean(ShowerLoft) Turn On(StereoExpensive) Clean(BathtubModern) Clean(ToiletStall) Clean(Toilet |
| BeHostAtParty | Make Refreshing Drinks(BarModern) Make Refreshing Drinks(BarModern) (FridgeDrawer) Serve Delightful Hot Beverage |
| ChildEnjoyParty | Play Video Game(TVWall) |
| TeenEnjoyParty | Dance(StereoExpensive) Turn On(StereoExpensive) |
| AdultEnjoyParty | Dance(StereoExpensive) Turn On(StereoExpensive) |
| PrepareForFuneral | Clean(C4) Clean(C6) Clean(ToiletStall) Clean(ToiletStall) Clean(ToiletStall) Clean(ToiletStall) Clean(C457) Clean(C458) |
| BeGuestAtFuneral | Sit(ChairDiningModerate) Sit(ChairDiningModerate) Sit(ChairDiningModerate) Sit(ChairLivingDesigner) Sit(ChairLivingDesi |
| StayAtVenue | Sit(ChairDiningModerate) Sit(ChairDiningModerate) Sit(ChairDiningModerate) Sit(BathtubModern) Sit(ChairLivingDesigner) |
| BeInGym | Pump Iron(WorkoutBench) ***** Gameplay/Abstracts/ScriptObject/GetInPool:InteractionName *****(Pool) Work Out(Treadmi |
| BeInArtGallery | View(UberBoxPedestal) View(SculptureVaseContemporary) View(SculptureVaseContemporary) View(SculpturePlantPhilo |
| BeAtSwimmingPool | ***** Gameplay/Abstracts/ScriptObject/GetInPool:InteractionName *****(Pool) Swim(Pool) Relax(ChairLoungeModern) Rela |
| BeSuspicious | Look In Window(WindowFullContemporary2x1) Look In Window(WindowFullContemporary2x1) Look In Window(WindowFu |
| BeMaid | Clean(C4) Clean(C6) Clean(ShowerLoft) Clean(BathtubModern) Clean(ToiletStall) Clean(ToiletStall) Take Out Trash(Trash |
| BeRepairman | Repair Shower(ShowerLoft) Repair(StereoExpensive) Repair(BathtubModern) Unclog(ToiletStall) Unclog(ToiletStall) Uncl |
| KeepSwimming | Swim(Pool) |
| RelieveNausea | Vomit(ToiletStall) Vomit(ToiletStall) Vomit(ToiletStall) Vomit(ToiletStall) |

# Simulating a Larger World

- Hierarchical Planning
- Commodity-Interaction maps
- **Auto-satisfy curves**
- Story-progression

# Auto-Satisfy Curves

Motives

Menu  Add Motive  Remove Motive  Copy Motive

| Motive | Intensity | InitialMin | InitialMax | HasDef... | Trigger... | TriggerValu... | AddBuff | RemoveBuff | CustomClass | Trigger... | TriggerValu... | AddBuff |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bladder | 4000 | 75 | 100 | True | -100 | -91 | ReallyHasT... | | | -90 | -61 | HasToPee |
| Bladder age: Tod... | 4000 | 75 | 100 | True | -100 | -91 | ReallyHasT... | | | -90 | -61 | HasToPee |
| Bladder age: Baby | 4000 | 95 | 100 | True | -100 | -91 | ReallyHasT... | | | -90 | -61 | HasToPee |
| Bladder age: Elder | 4000 | 90 | 100 | True | -100 | -91 | ReallyHasT... | | | -90 | -61 | HasToPee |
| Hunger | 10000 | 0 | 0 | False | -100 | -81 | Starving | | | -80 | -61 | VeryHungry |
| Hunger age: Tod... | 10000 | 0 | 0 | False | -100 | -81 | Starving | | | -80 | -61 | VeryHungry |
| Hunger age: Baby | 10000 | 0 | 0 | False | -100 | -81 | Starving | | | -80 | -61 | VeryHungry |
| Energy | 4000 | 83 | 83 | False | -100 | -100 | Exhausted | | | -99 | -80 | Tired |
| Energy age: Baby | 4000 | 83 | 83 | False | -100 | -100 | Exhausted | | | -99 | -80 | Tired |
| Energy age: Tod... | 4000 | 83 | 83 | False | -100 | -100 | Exhausted | | | -99 | -80 | Tired |
| Fun | 1250 | 0 | 0 | True | 0 | 100 | | Overworked | | -100 | -51 | Stressed |
| Hygiene | 700 | 80 | 95 | True | -100 | -81 | Smelly | SqueakyClean, Grungy | | -80 | -61 | Grungy |
| Hygiene age: Baby | 5000 | 80 | 95 | True | -100 | -81 | Smelly | SqueakyClean, Grungy | | -80 | -61 | Grungy |
| Hygiene age: To... | 5000 | 80 | 95 | True | -100 | -81 | Smelly | SqueakyClean, Grungy | | -80 | -61 | Grungy |
| Work | 1000 | 0 | 0 | True | | | | | | | | |
| GoHome | 0 | 0 | 0 | False | | | | | | | | |
| Social | 400 | 95 | 100 | True | -100 | -99 | Desolate | Lonely | | -98 | -61 | Lonely |
| Social age: Baby | 2000 | 95 | 100 | True | -100 | -89 | Desolate | Lonely | | -88 | -61 | Lonely |
| Social age: Toddler | 2000 | 95 | 100 | True | -100 | -89 | Desolate | Lonely | | -88 | -61 | Lonely |

☑ Universal  ☐ Insatiable

Initial Value
- ◉ From Auto-Satisfy Curve
- ○ Fixed

Time Randomness: 0.5

Decay
- ○ No Decay
- ○ From Auto-Satisfy Curve
- ○ Decay to Zero
- ○ Fixed Decay
- ◉ Variable Decay By Moodlet

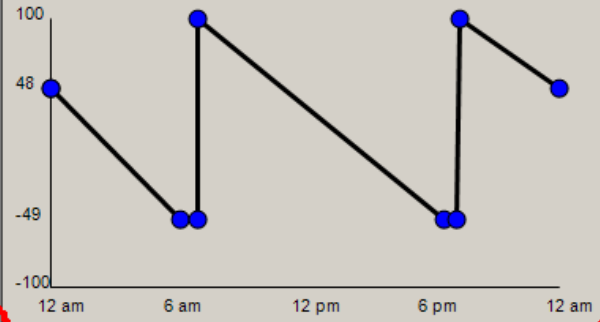
Configure Moodlet Decay

☐ Show Decay

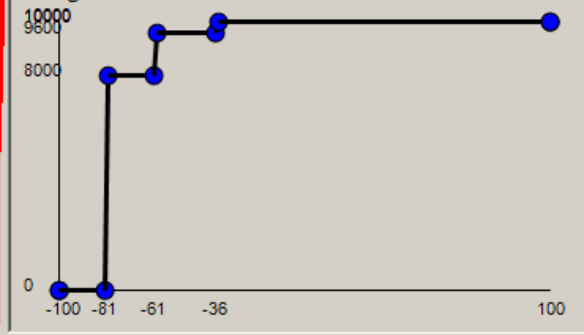
Specificity

Age:  Trait:

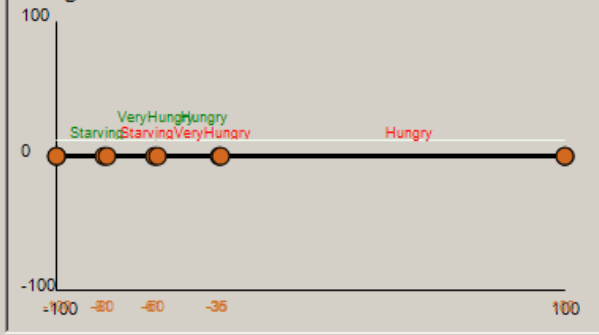
Hunger Auto Satisfy




Hunger Desire




Hunger Mood Contribution

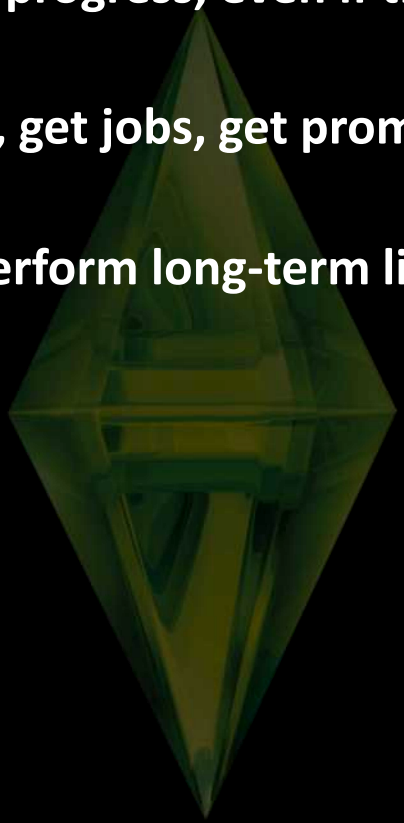


# Simulating a Larger World

- Hierarchical Planning
- Commodity-Interaction maps
- Auto-satisfy curves
- **Story-progression**

# Story Progression

- Other Sims need to make progress, even if they are not being fully simulated
- They need to get married, get jobs, get promoted, have children,  move home, etc.
- Solution: low LOD Sims perform long-term life-actions at a low frequency



# Story Progression

- Ray Mazza

- Peter Ingebretson

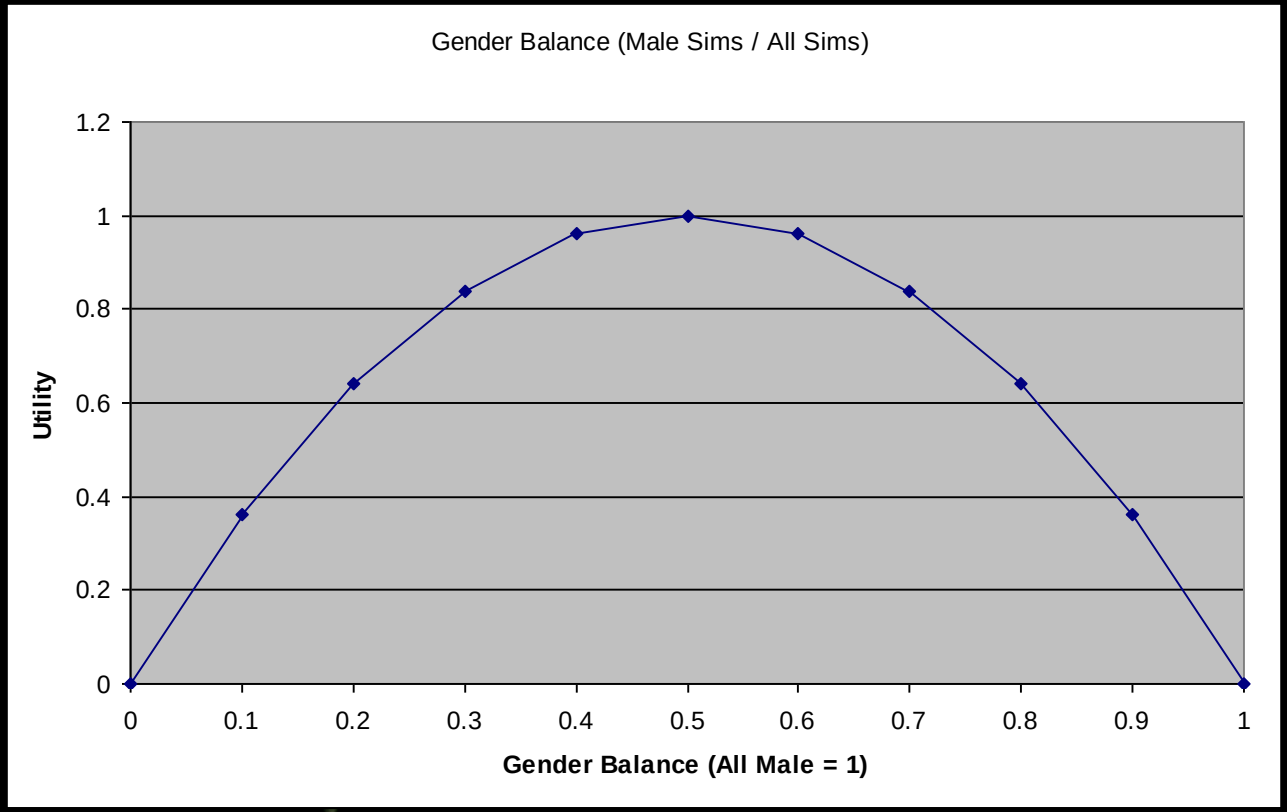
# Story Progression

- **The town has various meta-level desires**
- **It uses these life-actions to satisfy its own desires**
- Example:
  - Sim has hunger desire, satisfied by eating and drinking.
  - Town has gender ratio desire, satisfied by creating and destroying Sims

- > Movie 2

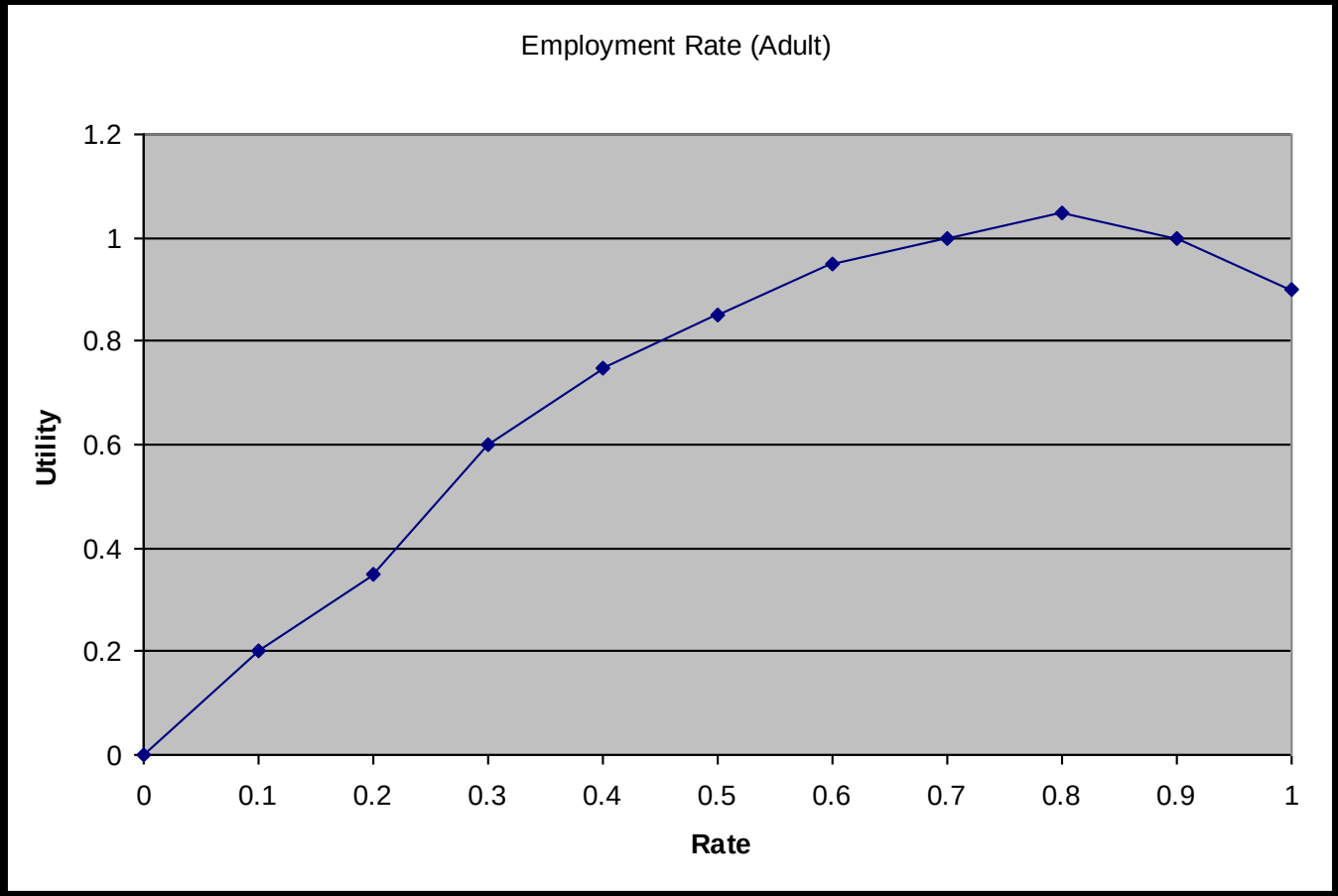
# Story Progression: Gender Balance

- Create Household
- Create and Move In
- Emigrate Household
- Have Baby
- Add Sim
- Kill Sim



# Story Progression: Employment Rate

- Get Job
- Quit Job
- Get Fired

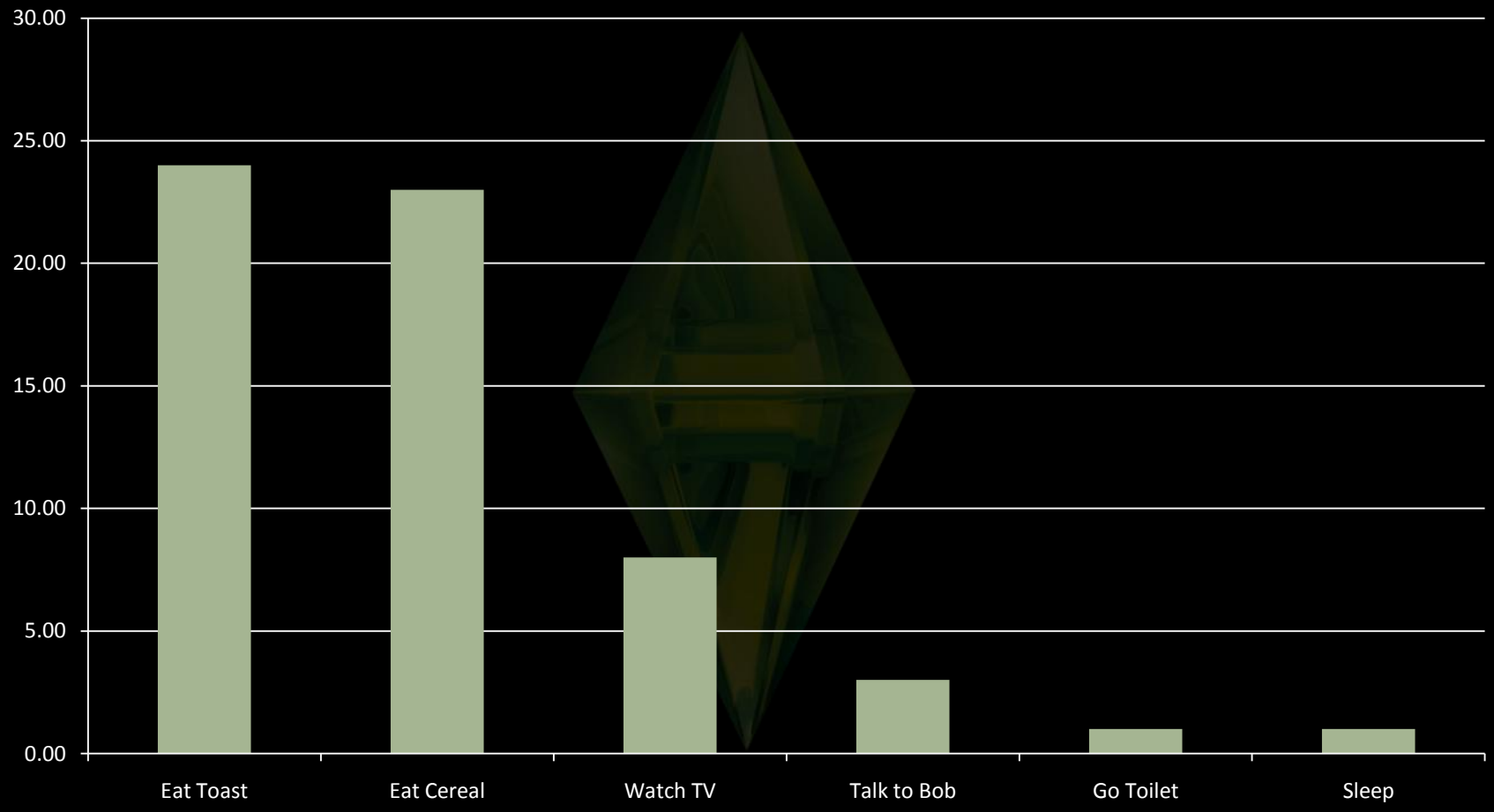


# Two Big Challenges

- Simulate a larger world
- **Make unique Sims**

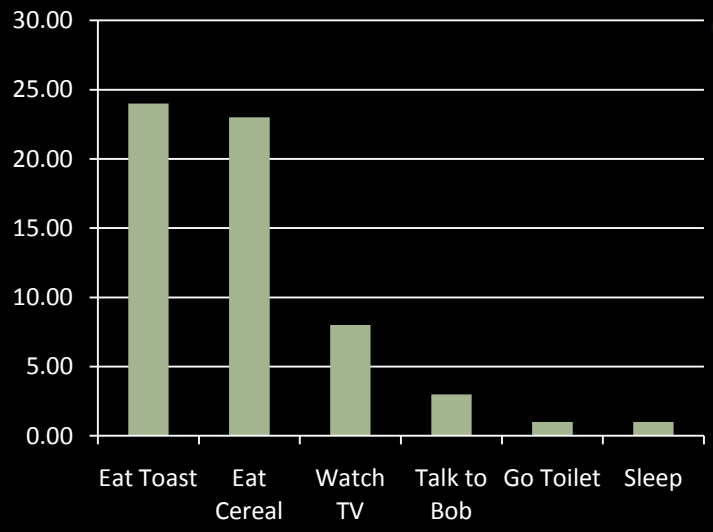
# Making Sims Who Can Look After Themselves

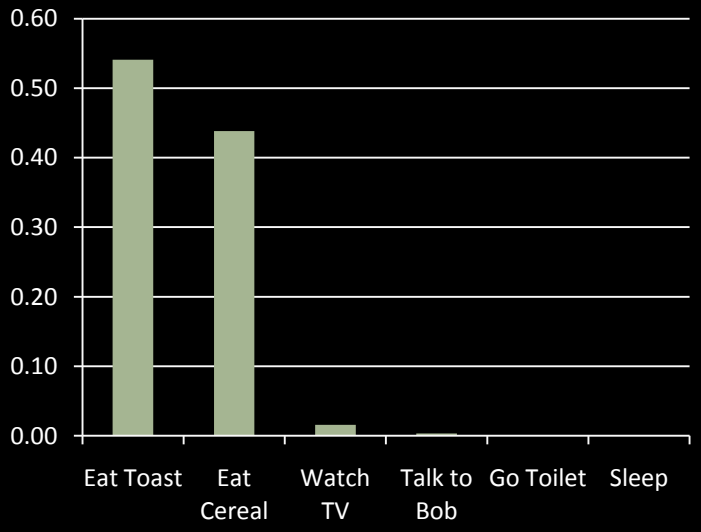
# Deciding What To Do



# Different Ways of Deciding What To Do

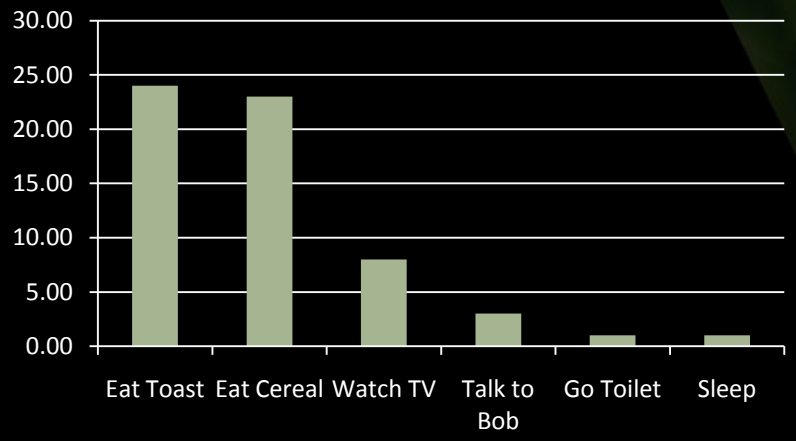
- Always choose the highest-scoring action
- Choose randomly from one of the n highest-scoring actions
- Choose randomly using the score distribution as the probability distribution

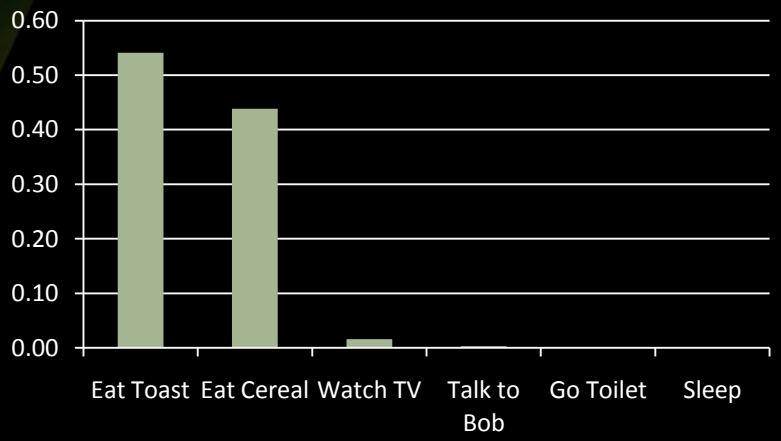


# Converting Utility into Probability

$$p = e^{s/T} - 1$$



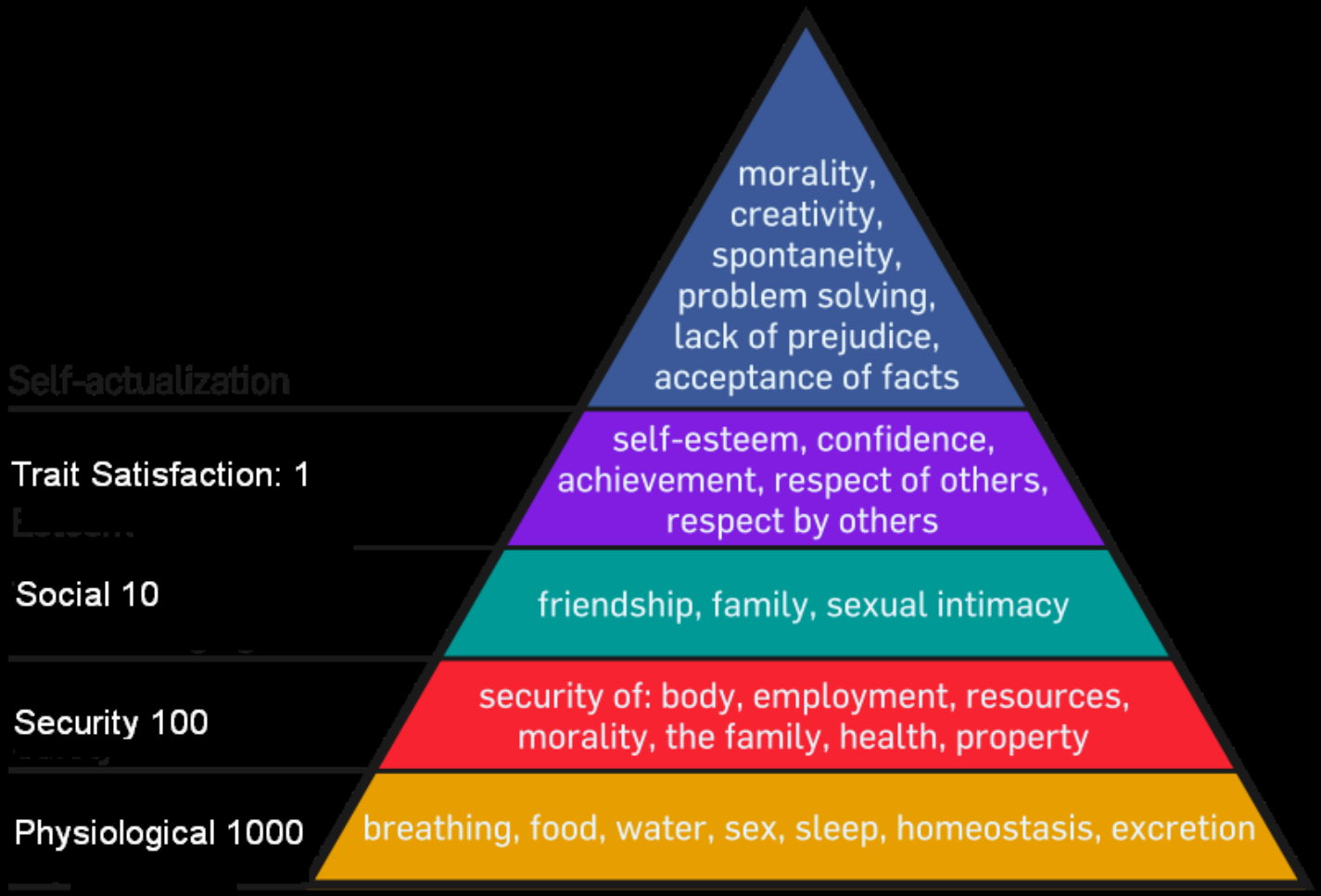
# Converting Utility into Probability

$$p = e^{s/T} - 1$$

- S is the score
- P is the probability
- T is the temperature
- This is a simplified Boltzmann function

- Temperature should be cool when he is happy, and should go up when the Sim is doing badly

# Using Maslow's Hierarchy of Needs for Tuning



# Unique Sims

# Two Big Challenges

- Simulate a larger world
- **Make unique Sims**

# Unique Sims

- We wanted to make a town full of distinct individuals
- We wanted their personalities to be *obvious* to the casual observer

# Unique Personality

- A personality is a bag of traits
- Each Sim can have up to 5 traits from a pool of about 80

# Traits Affect Affordances

- Kleptomaniacs can steal
- Pyromaniacs can set things on fire
- An inappropriate Sim might use the computer to troll people on internet forums
- Over-emotional Sims may cry while watching romantic television

# Traits affect *adverbs*

- Traits provide *adverbial modifiers* on common actions
- Traits affect the way you *walk*
  - Grumpy Sims walk around muttering under their breath
  - Clumsy Sims will trip themselves up
- Traits affect the way you *wait*
  - Slobs will fart and burp
  - Insane Sims will talk to imaginary people
  - Workaholics will pull out their cell-phone
- Traits affect the way you *look*
  - Neurotic Sims are twitchy - always looking around
  - Flirty Sims are always checking other people out
- Traits affect the way you *respond*
  - Force a vegetarian to eat meat!
  - Force a hydrophobic Sim into the pool!

# Traits Affect Autonomy

- The ways in which traits affect behavior are cool, but uninteresting from an AI perspective
- It is how traits affect *autonomy* that is our focus today

# Data-Drive Everything

- As good software engineers, we must minimize the arrows between code systems
  - When designing the API between different systems at the code level, we want as few functions as possible
- But as designers, we must *maximize* the arrows between design systems
  - The richness of a design comes from the myriad functional interconnections between gameplay elements
- How can we have both?
- We create massively data-driven systems in which interconnections between gameplay elements can be added without touching the code

# Minimize the Arrows between Code Elements

- What we don't want, in the middle of FindBestAction:

```
if (sim.HasTrait(Bookworm) && object is Book)
{
   score *= 1.5;
}
```

- > Movie 3

# Traits and Motives

- There is a new motive for each trait
- Different Sims have different wants
- By satisfying their unique wants, they are manifesting their individual personality autonomously
- Examples:
  - A mean-spirited Sim has an extra motive, encouraging him to insult people, mock people, and laugh at them when they are in distress
  - A couch potato has an extra motive, encouraging him to watch TV and nap during the day

# Traits and Autonomy

- This is what Tamara did between Sunday 2.32 PM and 6.26 PM (from our interaction-logs)
  - Gussy Up in front of the mirror
  - Chat
  - Mooch Food off her room-mate, CyclOn3 Sw0rd
  - Eat Cereal
  - Compliment CyclOn3's Appearance
  - Make a flirtatious joke
- Can you read her personality from her actions?

# Traits and Motives

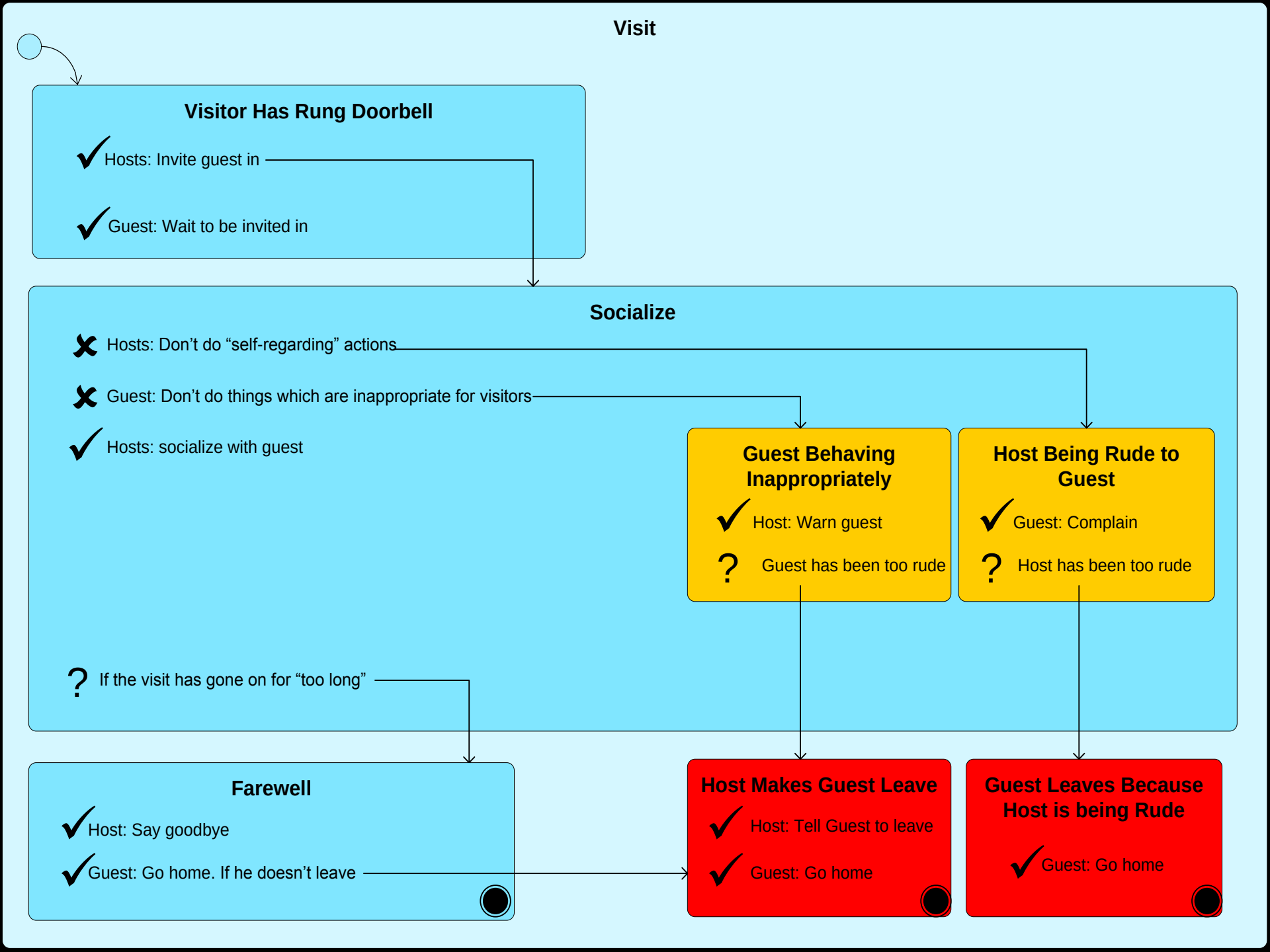
- You can infer their personalities from what they do

- > Movie 4

# Traits and Motives

- In Sims 1 & 2, every Sim had the same 8 motives
- In Sims 3, each Sim has a different set of motives, based on his traits
- But the set of motives doesn't just vary between individuals, it also varies within the *same individual* over time
- We add and remove motives through time, to model a Sim's understanding of social norms

- > Movie 5


Visit
Visitor Has Rung Doorbell
Hosts: Invite guest in
Guest: Wait to be invited in
Socialize
Hosts: Don't do "self-regarding" actions
Guest: Don't do things which are inappropriate for visitors
Hosts: socialize with guest
Guest Behaving Inappropriately
Host: Warn guest
Guest has been too rude
Host Being Rude to Guest
Guest: Complain
Host has been too rude
If the visit has gone on for "too long"
Farewell
Host: Say goodbye
Guest: Go home. If he doesn't leave
Host Makes Guest Leave
Host: Tell Guest to leave
Guest: Go home
Guest Leaves Because Host is being Rude
Guest: Go home

# Adding Motives to Model Social Situations

- Example: when a guest visits your house, the hosts are given a motive to pay some attention to the guest, and the guest is given a motive to behave appropriately as a visitor. This motive lasts as long as the visit.
- But Sims with different traits have different interpretations of the social-appropriateness motive during visiting. Insane Sims, for example, care not a jot for it. So insane Sims will walk straight into your house and eat your food and sleep on your bed, much to the consternation of the hosts!

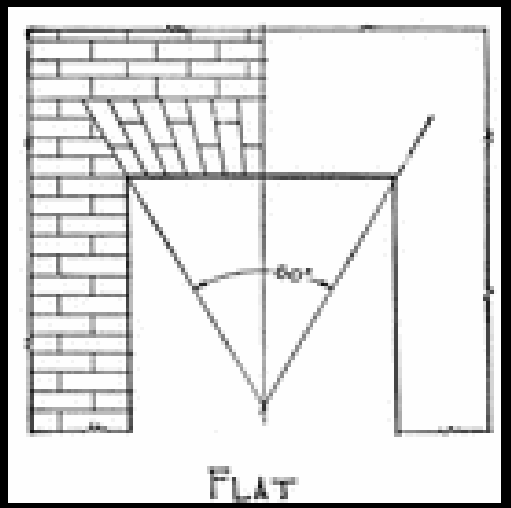
# Adding Motives to Model Social Situations

- Example #2: when a Sim sits down to have a picnic, his friends and family are gently encouraged to join him, to encourage social cohesiveness at the park. Sims who do not know the picnickers will not be encouraged to sit with them.
- But Sims with different traits have different understandings of the social norms – inappropriate Sims will actively go out of their way to sit down with people they don't know, and make them feel uncomfortable

- > Movie 6

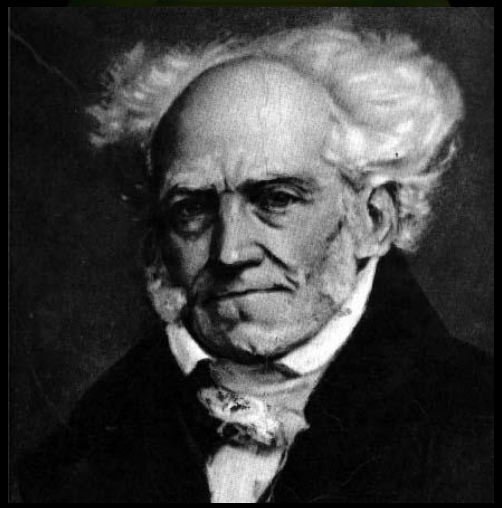
# Modeling Social Situations to Manifest Traits

- Modeling social situations and modeling individual traits are complementary activities
- The more accurately we model social situations, the more the individual traits will be able to shine through
- Individuality and Sociability are mutually supporting



# Pretentious Quote

- “The revelation of the Idea of man is accomplished chiefly by two means: by accurate drawings of *significant characters*, and by the invention of *poignant situations in which they reveal themselves*” (Schopenhauer, The World as Will and Representation, Book III)



# System Granularity

- Different systems should be of similar levels of granularity
- If we are going to have much finer-grained personalities, we are going to need much finer-grained social interactions to support them
- Sims 1 and 2 had very broad speech-acts
  - Talk
  - Joke
- In Sims 3, we have more specific contextual socials. For example:
  - Compliment Home
  - Worry About Relationship
- These fine-grained socials allow us to express our fine-grained personalities

# How Traits Affect Socializing

- Traits affect which social interactions they choose autonomously
  - Snobs like to boast about their cars
  - Neurotic Sims will accuse their partner of cheating on them
  - If a mean-spirited Sim finds out the person he is talking to is a vegetarian, he is apt to mock her vegetarianism!

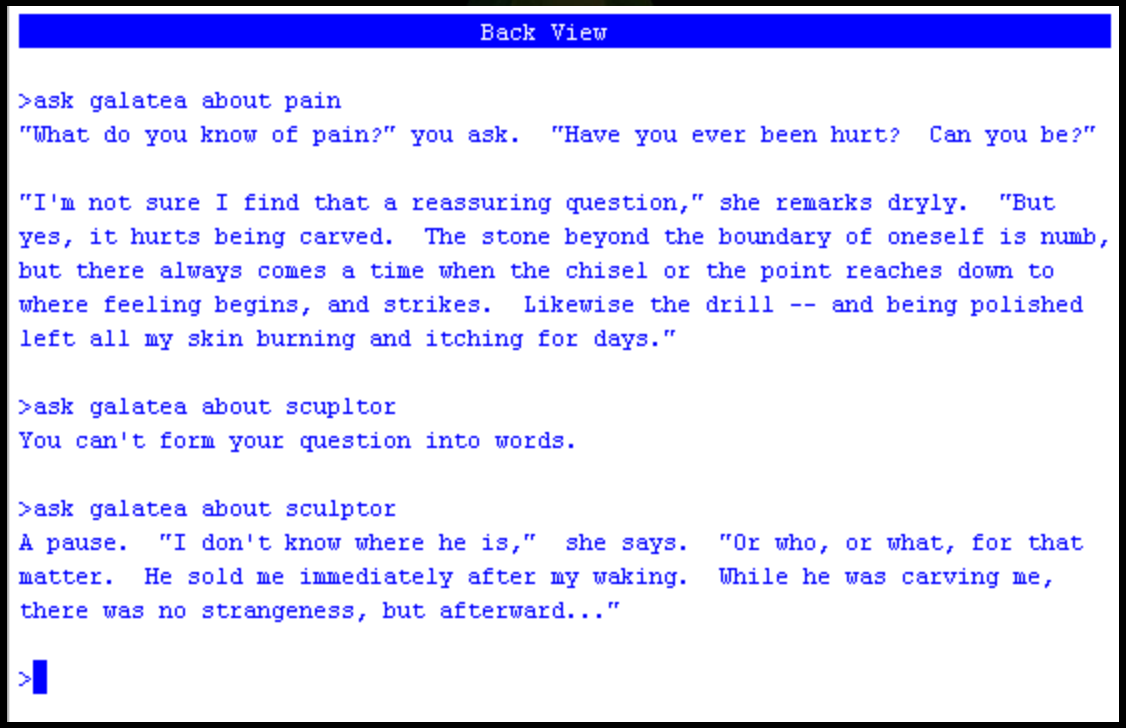
# How Traits Affect Socializing

- Traits also affect how they respond to social interactions initiated by others
- How a Sim responds to a social depends on a series of production-rules:

```
TryingToBe.Funny -> Neutral
TryingToBe.Funny && Repetition -> Boring
TryingToBe.Funny && LTR < -20 -> Insulting
TryingToBe.Funny && Target.GoodSenseOfHumor -> Funny
```

# Interactive Fiction as Inspiration

- Inform 7 uses production rules as the fundamental unit of representation
- In some of Emily Short's work, the conversation is an end in itself.



# Treating People as Ends

- Act in such a way that you treat humanity, whether in your own person or in the person of any other, always at the same time as an end and never merely as a means to an end. ” (Groundwork of the Metaphysics of Morals, second formulation of the categorical imperative)

- > Movie 7

# How Traits Affect Socializing

- Production-rules are ranked by specificity
- The most specific rule fires
- Often, the traits of the actor or the target determine the outcome
- When a rule fires, the other Sim learns the trait
- Thus, trait learning is contextual

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# Does the Social System Answer the Photoshop Challenge?

- The field of computer graphics is way more advanced than AI in games
- This is because graphics has a clean decomposition of form/function in terms of texture/polygon
  - Artists are free to add any texture they like
  - Graphics engineers deal with polygons
- There is no analog in AI of the texture/polygon decomposition

# Does the Social System Answer the Photoshop Challenge?

- The underlying explanation for the success of computer graphics is that artists have an object (the texture) which they can manipulate freely, without worrying about side-effects.
  - You can cut part of a texture out and it is still a valid texture
  - You can merge two textures together, and it is still a valid texture
- This is because the texture is homeomerous: a part of a texture is itself a texture

# Pretentious Word for the Day: Homeomerous

- From Greek: “Homo” + “meros” : the part is the same
- Butter is homeomerous
- Human is not

# Production-Rules are Homeomerous

- What we want, then, is a homeomerous unit for game AI.
- It certainly isn't the script: part of a script isn't a script (it doesn't even compile, let alone run).
- What is the homeomerous unit for game AI? The production-rule!
  - You can cut conditions out of a production-rule, and it is still a production-rule
  - You can blend two production-rules together, and it is still a production-rule

# Does the Social System Answer the Photoshop Challenge?

- Producers added hundreds of social interactions
- Producers added thousands of production rules
- They were adding content in a safe environment: they couldn't crash the system or cause an infinite loop

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# Traits Create Emergent Drama

- Trait-conflict creates tension
  - Put a computer whiz and a technophobe in the same house
  - Put a neat Sim and a slob in the same house, and watch the sparks fly!
- The same action creates very different stories when the Sims have different traits
  - A mean-spirited Sim goes up to a stranger and asks him about his career
  - In one case, you learn he is a policeman. Now your mean-spirited Sim can complain about the police.
  - In the second case, you learn he is unemployed. The conversation turns awkward.
  - In the third case, you learn he is unemployed – but this time he is hot-headed. He doesn't like to be reminded he doesn't have a job, and gets angry.

# A Town of Individuals

- Sunset Valley is a town full of individuals
- The more you play, the more you get to know their individual quirks
- You get to know them, and they get to know you

# Take-Home Actionable Items

- Data-drive everything!
- Take the time to make good in-game visualization tools!
- Prove out all simulation ideas using prototypes!

- > Movie 8

# Thanks

- Thanks to the Sims 3 team! ☺