

Random Walks and More About Visualization

Chapter 16

These walks seem random

- Walk This Way, Aerosmith (Run DMC)
- A Walk in the Clouds, Keanu Reeves
- Walking Tall, Sherriff Buford T Pusser
- Walking Dead, Zombies
- Walk the Plank, Pirates
- You'll Never Walk Alone, Carousel & Association Football
- [Ministry of Funny Walks](#)

But seriously

- So far, we have focused on **deterministic programs**
 - Given a set of inputs – the output will always be the same
- Many problems are **stochastic**
 - Dependent on **random events**
 - We can rarely state exactly what will happen
 - Instead, we make **probabilistic** statements about what might happen

Simulation models

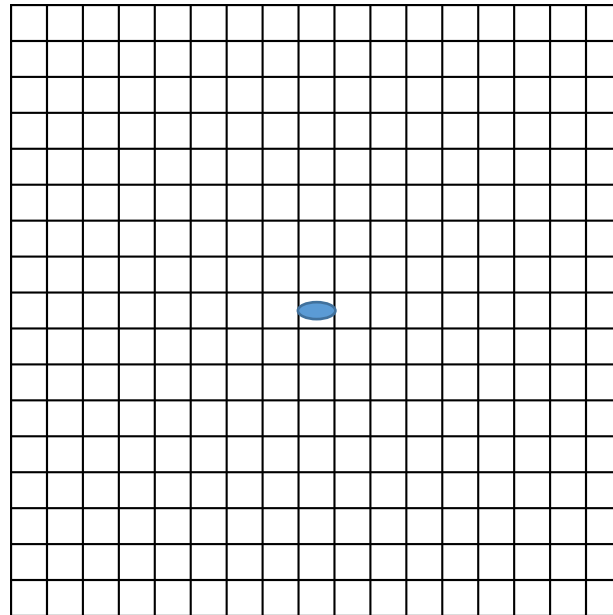
- Attempts to mimic the real world
 - Based on what is likely to happen
 - i.e. I am likely to make my next mortgage payment on time and in the exact amount expected
 - “All models are wrong, but some are useful”, George E Box(?)

Random Walks

- A type of simulation model
- Often used to model physical or biological processes
 - Diffusion
 - Displacement of RNA by DNA
- Why study random walks?
 - They are interesting and widely used
 - Good example of abstraction and inheritance to model
 - We get to learn new Python and programming techniques!

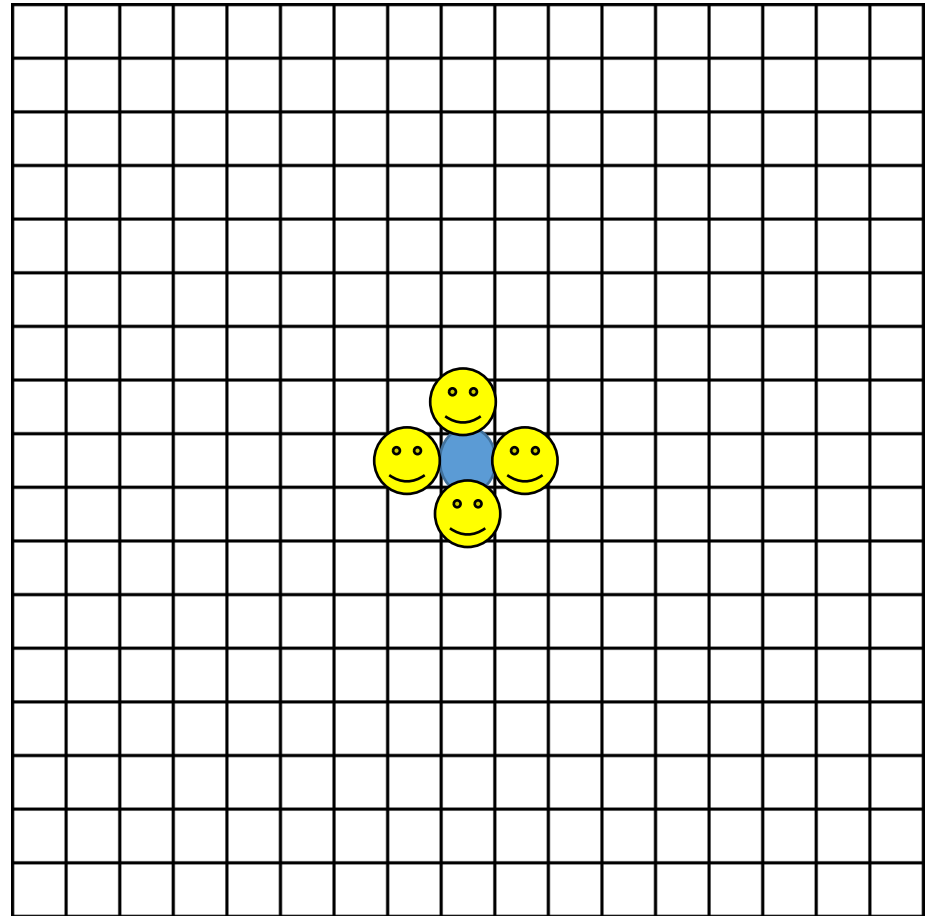
The Drunkard's Walk

- Assume an intoxicated person wakes up in the middle of a field
- Every second the drunk takes a step in a random *cardinal* direction
 - North, South, East or West
- How far will the drunk be from where they started in n seconds?



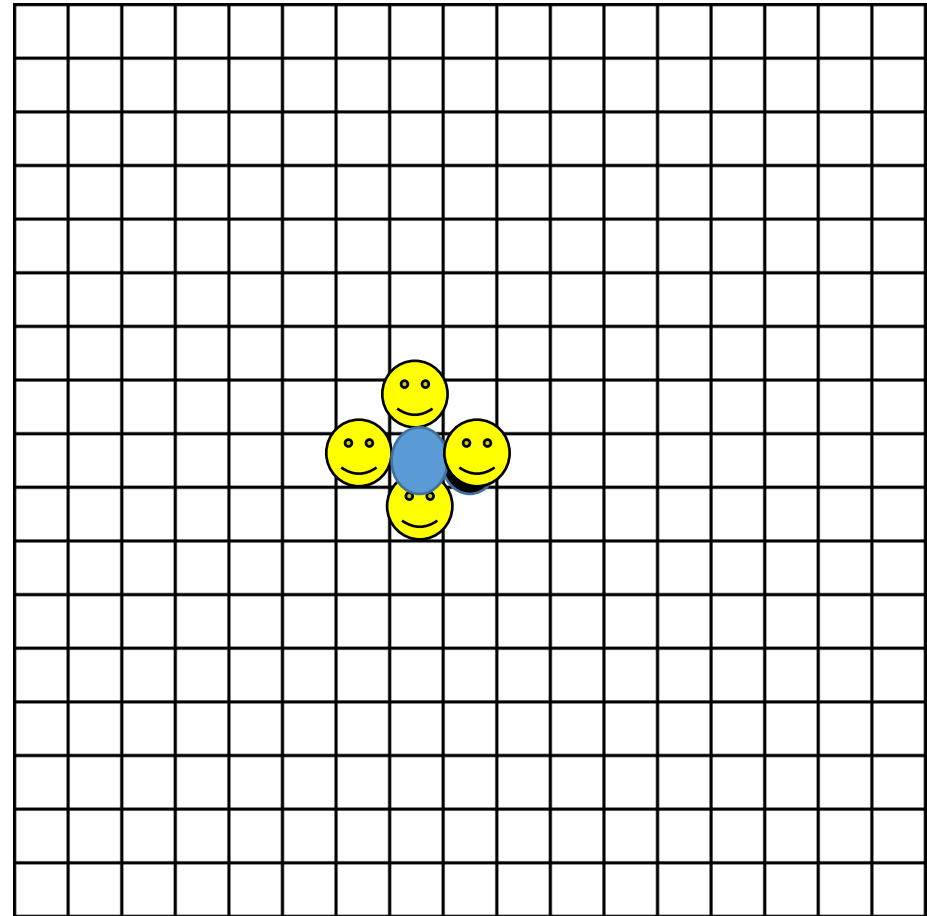
Step 1

- Drunk will move 1 step away from origin
- 25% chance in any one direction



Step 2

- Let's say the drunk moves left on step 1
 - 25% right back to origin and be 0 steps away
 - 25% left again and be 2 steps away
 - 50% forward or backward and be $\sqrt{2}$ steps away



What about step 3

- Each possible step has a 25% chance
 - But it is dependent on step 2
 - So a 6.25% chance
 - But there is overlap
- This is getting tedious
- I know let's write a program to help figure this out!
- What do we need?
 - Drunk
 - Location
 - Field

“All models are wrong, but some are useful”

- In what ways is our model wrong?

Biased Random Walks

- The strength of an effect might be greater in one direction
- The chance of a particular effect might be greater in one direction
 - Biased towards a goal
 - To or away from a stimulus

Observations on simulations

- First, build classes relevant to simulation
- Create simulation functions
- Now we can try different types of 'actors' (Drunk)
- Only the simulation need change
 - Base classes can remain the same
- Used Data visualization to better understand the data
 - [INFO H 517 Visualization, Design and Analysis](#)