CDS 230
Modeling and Simulation I
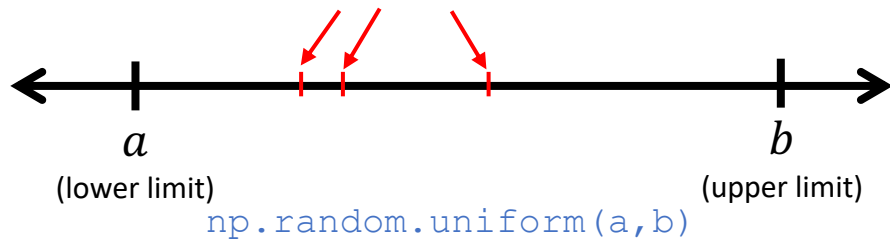
Module 9

Modeling Uncertainty Examples

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Recap

Equal chances   vs.   Unequal chances

Any arbitrary points within lower (a) and upper (b) limits have equal chances to be selected.

`np.random.uniform(a,b)`

Any integers within lower (c) and upper (d) limits have equal chances to be selected.

`np.random.randint(c,d+1)`

$p_1 > p_2$
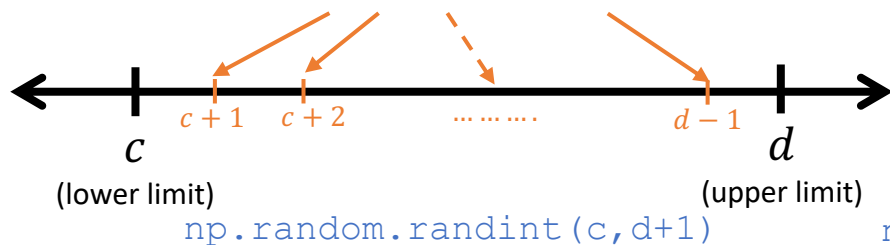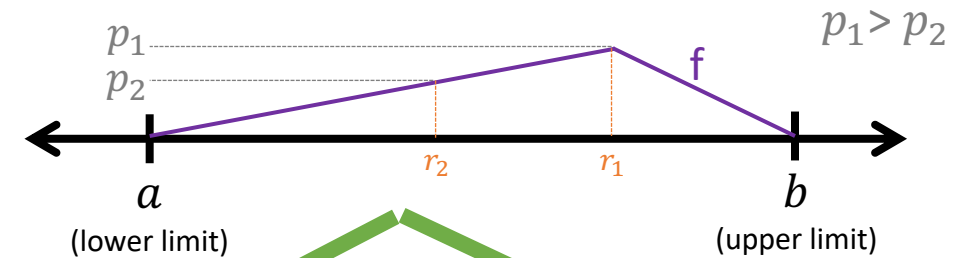
Normal distribution
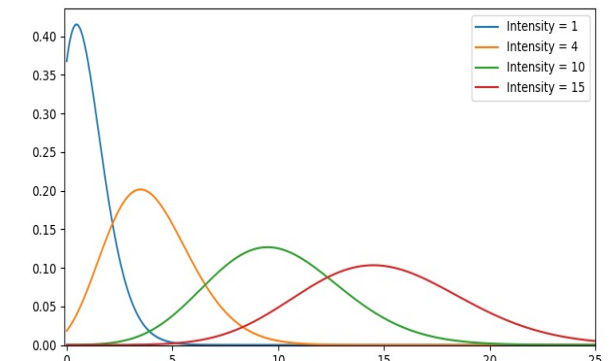
`numpy.random.normal(loc, scale, size)`

Poisson distribution

`numpy.random.poisson(lam, size)`

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Suggest me some fruit

- Assume that you feel too tired to decide what fruits to eat. Write a function called `fruit_suggestion` which will return the name of two different fruits randomly.

  - Available fruits are: "Grapefruit","Pineapple","Avocado","Blueberries","Apples","Pomegranate","Mango","Strawberries","Cranberries","Lemons","Watermelon","Olives","Blackberries","Oranges","Bananas"

  - Example output

  ```
  fruit_suggestion()
  ```

  ```
  'Mango and Watermelon'
  ```

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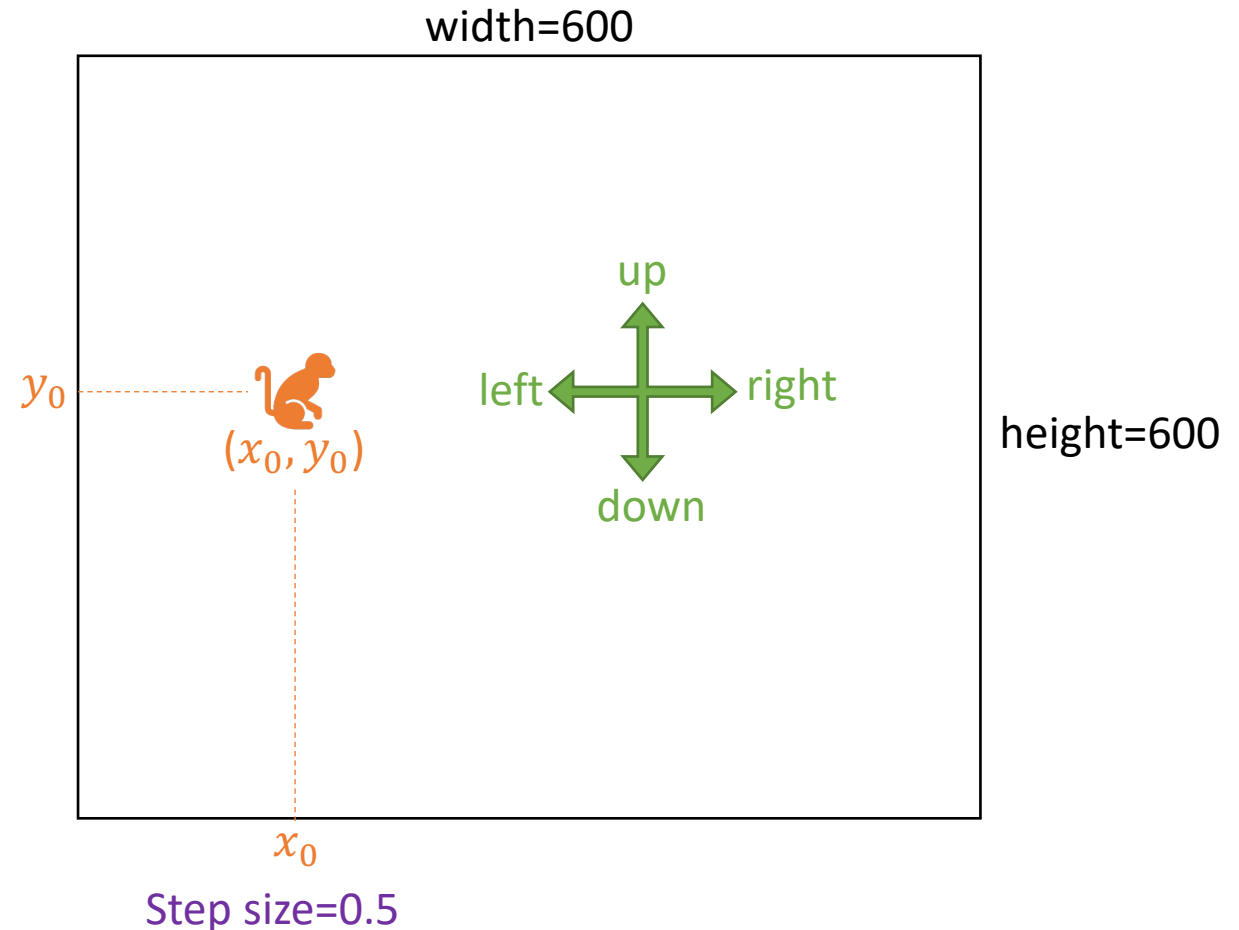
Dice examples

1. Roll a fair die.

2. Roll three fair dice.

3. Roll a fixed (unfair) die.
   - How fixed: 1=10%, 2=10%, 3=20%, 4=10%, 5=10%, 6=40%

4. Roll three fixed (unfair) dice.
   - How fixed: 1=10%, 2=10%, 3=50%, 4=10%, 5=20%, 6=0%

5. Roll two fair and two fixed (unfair) dice.
   - How fixed: 1=20%, 2=20%, 3=17%, 4=15%, 5=14%, 6=14%

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Bonus question (+10 pts)

- How would you spot an unfair die?

Random walk example

- Movement of some animals is characterized by random walk.

- A simple random walk algorithm
  1. Identify an area
  2. Identify a step size for the animal
  3. Locate the animal at an initial coordinate randomly
  4. Select a direction at random and move a step size in that direction.
     - If a step goes out of boundary, take a step in the opposite direction
  5. Repeat step 4, X times

width=600

height=600

up

left   right

down

y_0

(x_0, y_0)

x_0

Step size=0.5

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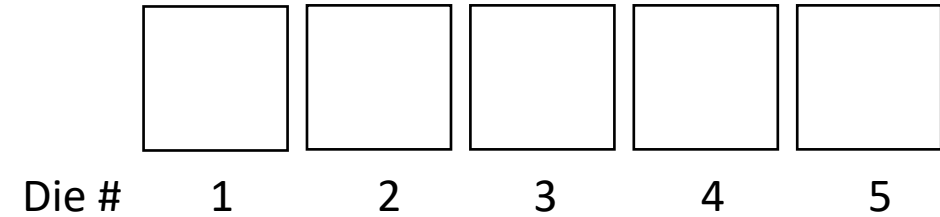
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Card game example

1. Create 52 cards, values ranging from 1 to 13 per suite
2. Shuffle cards.
3. Discard the first four cards.
4. Distribute the remaining 48 cards to four players (12 cards per player).
5. Each player selects one card at a time and puts that card on the table.
6. Once the fourth player puts the selected card, the card with highest number wins all the cards (sum of scores).
7. Repeat Steps 5 and 6 until all cards are used.
8. Print the score of each player.

Yahtzee example

- A classic multiplayer board game played with five dice

- Players make certain dice combinations to score

- At each turn, a player has three chances
  - First chance: rolls all five dice at once
  - Second or third chances (optional): keep certain dice and re-roll the rest.
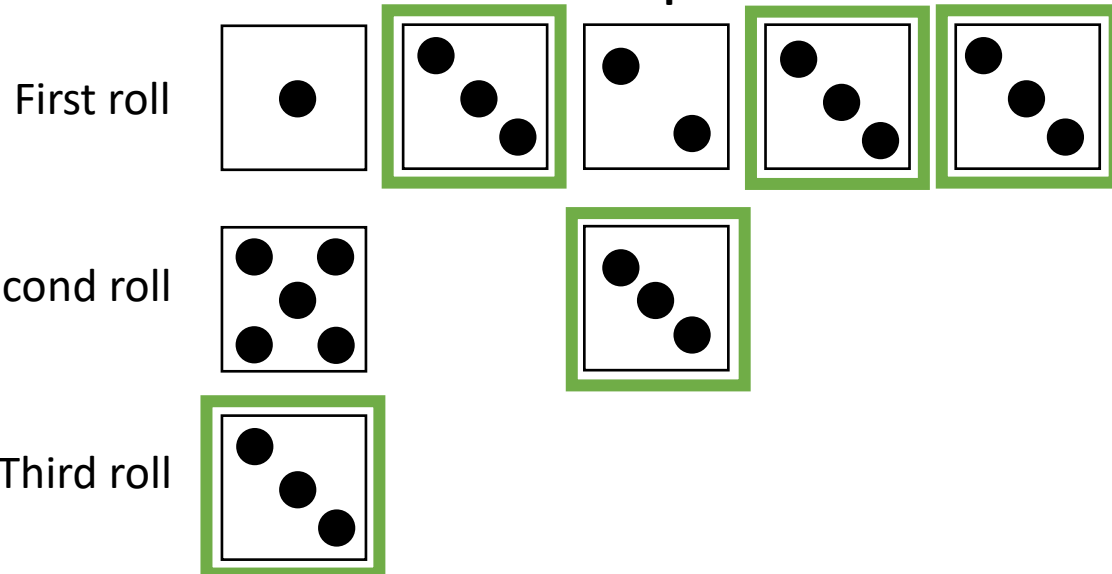 - A player can claim a combination at any of these three chances.

Die #   1   2   3   4   5

Source: https://www.maplesoft.com/support/helpJP/Maple/view.aspx?path=applications%2FYahtzee

Our simplified Yahtzee strategy

- Write a simple code that aims to score "Yahtzee" (all dice same face)
- At each run, our program only keeps the most repeating numbers and re-rolls the rest.
- In the end, prints all repeating numbers.

Example 1

First roll
Second roll
Third roll

Example 2

First roll
Second roll
Third roll