PRIORITY QUEUE REPORT

Davide Di Mauro

*Politecnico di Torino*

Student ID: 306089

[s306089@studenti.polito.it](mailto:s306089@studenti.polito.it)

## **Abstract**

**The main objective of this homework is to simulate a Galton-Watson process where** **the number of children of a node is described by a Poisson random variable with parameter lambda.**

# Assumptions

1. The number of children of a node is described by a Poisson random variable with parameter λ

# Simulation Parameters

The process has 3 input parameters: the λ of the Poisson random variable.

1. The λ of the Poisson random variable. λ = [0.6, 0.8, 0.9 0.95, 0.99, 1.01, 1.05, 1.1, 1.3]
2. The number of runs of each simulation to estimate the probability of survival
3. The maximum number of generations of the tree

# Algorithm

* **for each** λ **in** [0.6, 0.8, 0.9 0.95, 0.99, 1.01, 1.05, 1.1, 1.3]:
  + **for each** run **in** range(n\_runs):
    - n\_childs = 1
    - **for each** generation:
      * n = extract n\_childes values from a Poisson(λ)
      * n\_childs = sum(n)
      * compute stop\_condition
      * **if** λ > 1 and stop\_condition == 0:
        + **break**
      * **if** n\_childs == 0
        + **break**
    - save result
  + compute probability\_of\_survival
* **return**  probabilities\_of\_survival

# Computing the Moment Generating Function

Thus:

Where:

**…**

# Stop Condition

In order to efficiently simulate this process, we need to implement a stopping condition in the case where since the tree never goes extinct and grows really fast. To do so, we compute the probability of having 0 children at a generic generation n, which is the probability that all nodes have no children.

We stop our simulation when this probability is so close to 0 that python automatically rounds it to 0

# ResultsChart, histogram Description automatically generatedChart, histogram Description automatically generated

Chart, histogram

Description automatically generated

# Conclusions

From the results we can conclude that our simulation is working as expected and that the implemented stopping condition interrupts the simulation near the theoretical non-extinction condition.

The histogram of the probability distribution shows that with lambda = 0.8, the process ends with more than 80% probability in 5 generations.