

Name: Bauckhage, Christian

Signature: \_\_\_\_\_

MatNr: 123456789

( ) student at B-IT / RWTH Aachen

(X) student at University of Bonn

University of Bonn, B-IT

Game AI

Instructor: Prof. Dr.-Ing. Christian Bauckhage

"test" exam

**Note:** This is just a text exam ... in the real exam on Jul 16th, you will find administrative guidelines at this point. The following table is just a place holder.

for instructor's use

problem	points	score	problem	points	score
1	10		5	10	
2	12		6	8	
3	8		7	10	
4	10		8	12	

---

total score

---

**Problem 1:** stochastic processes

- a) **[2 points]** What is a stochastic process over a discrete, finite state space  $\mathcal{S} = \{s_1, s_2, \dots, s_m\}$  ?

A set of random variables  $\{X_t \mid t \in \mathbb{N}\}$  where  $X_t \in \mathcal{S}$ .

- b) **[2 points]** What is a discrete time Markov chain (DTMC) ?

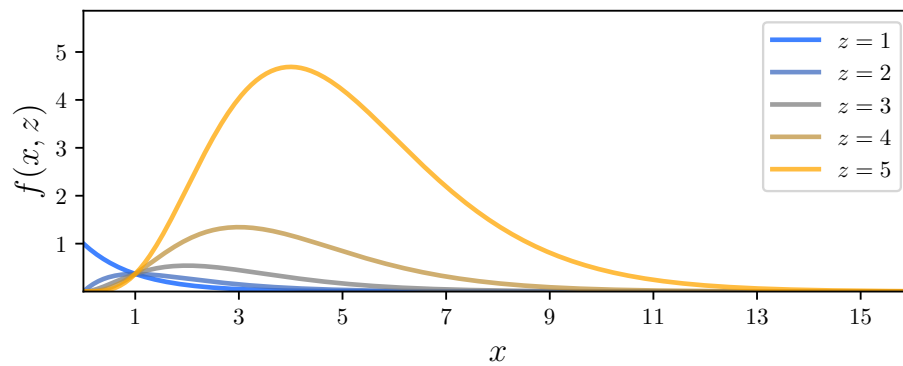
A stochastic process such that for all  $t \in \mathbb{N}$

$$p(X_t \mid X_{t-1}, \dots, X_0) = p(X_t \mid X_{t-1})$$

**Problem 2: Monte Carlo integration**

a) [4 points] Plot the gamma function

$$\Gamma(z) = \int_0^{\infty} x^{z-1} e^{-x} dx$$

for  $z \in \{1, 2, 3, 4, 5\}$ .

b) [4 points] Fill in the following table.

$z$	$(z-1)!$	$\Gamma(z)$
2	1	1
3	2	2
4	6	6
5	24	24
6	120	120

- b) **[4 points]** Show your python code for computing the entries of the above table.

```
import scipy as sp

for z in [2,3,4,5,6]:
    fact = sp.special.factorial(z-1)
    gamm = sp.special.gamma(z)
    print (fact, gamm)
```