

## CS234 - Winter 2021 - Quiz 0

1 What is the value of the **geometric series**  $\sum_{i=1}^{\infty} \gamma^i$  for some  $0 < \gamma < 1$  ?

- (a)  $\infty$
- (b)  $\frac{1}{1-\gamma}$
- (c)  $\frac{\gamma}{1-\gamma}$
- (d) undefined (the series does not converge)

**Solution:** (c), after using the definition of geometric sum from  $i = 0$  to  $\infty$  and subtracting the first value corresponding to  $i = 0$ .

2 Consider the vectors  $x_1 = [1, 0, 0]$  and  $x_2 = [0, 1, 0]$ . How many vectors  $v \in \mathbb{R}^3$  with unitary norm (i.e.,  $\|v\|_2 = 1$ ) are there that are orthogonal to  $x_1$  and  $x_2$  (i.e.,  $v^\top x_1 = 0$  and  $v^\top x_2 = 0$ )?

- (a) none
- (b) 1
- (c) 2
- (d)  $\infty$

**Solution:** (c), vectors  $[0, 0, 1]$  and  $[0, 0, -1]$ .

3 A lost tourist arrives at a point with 2 roads  $A$  and  $B$ . Road  $A$  leads to the city and takes either 1 or 3 hours, depending on traffic, with equal probability. Road  $B$  brings him to the city after 4 hours on average. Since there are no signs on the road, the tourist chooses a road with equal probability; what is the mean time until the tourist arrives to the city?

- (a) 2 hours
- (b) 2.5 hours
- (c) 3 hours
- (d) none of the above

**Solution:** (c), by conditional expectation:  $\frac{1}{2} \times (\frac{1}{2} \times 1 + \frac{1}{2} \times 3) + \frac{1}{2} \times 4$ .

4 In the lecture modules we showed that the Bellman operator is a contraction if  $\gamma < 1$ . Consider doing value iteration with  $\gamma = 0$ . How many iterations will it take for value iteration to converge to the optimal value function?

- (a) 1
- (b) 5
- (c) 100
- (d) unbounded

**Solution:** (a), as the best policy is immediately recovered by maximizing the instantaneous rewards.