Assignment A2b: Photon Detection

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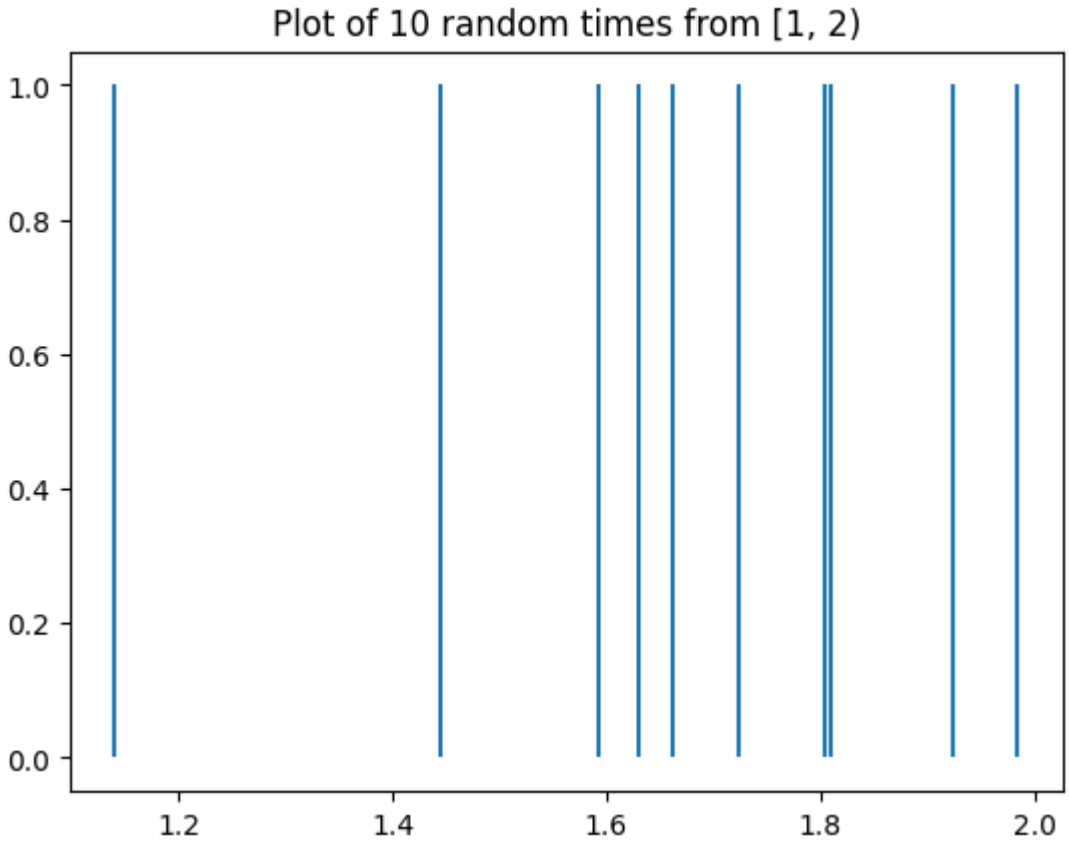
1. Simulating a dim flash of light

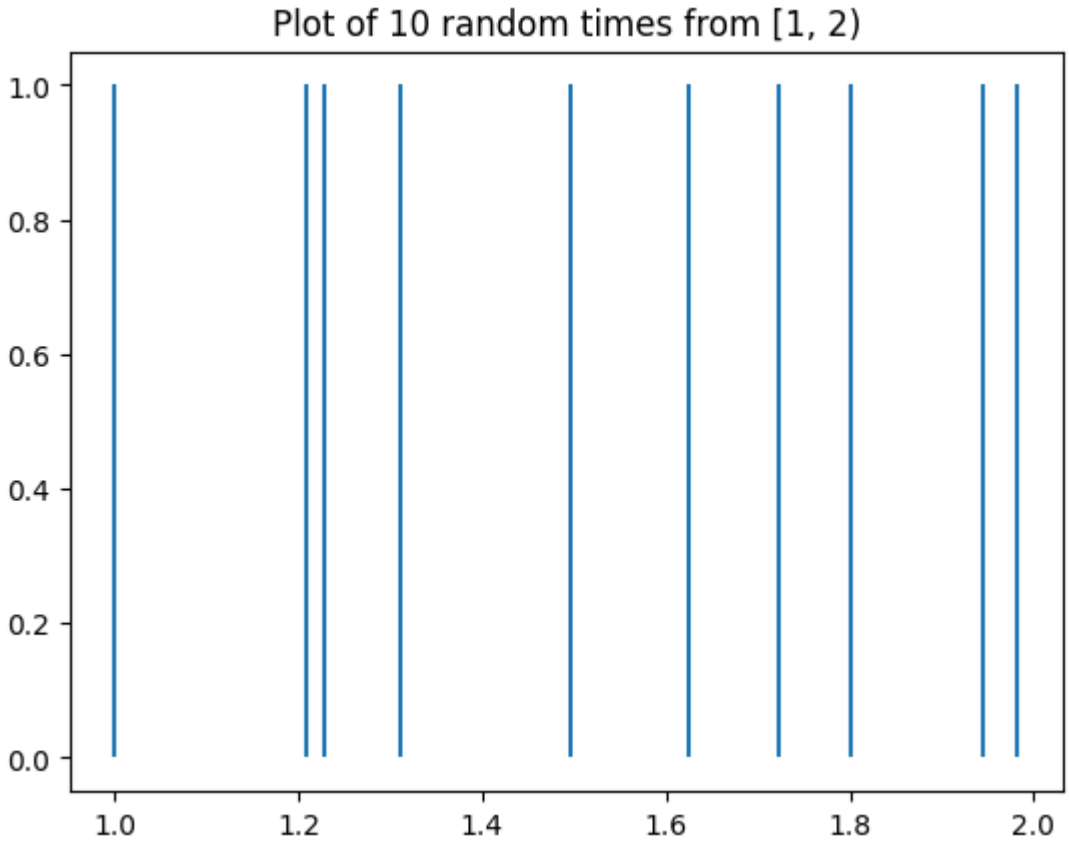
1a. Random times

In [1]:
```
from dim_flash import plotflash, randtimes

t = randtimes(10, t1=1, t2=2)
plotflash(t, t1=1, t2=2)
```

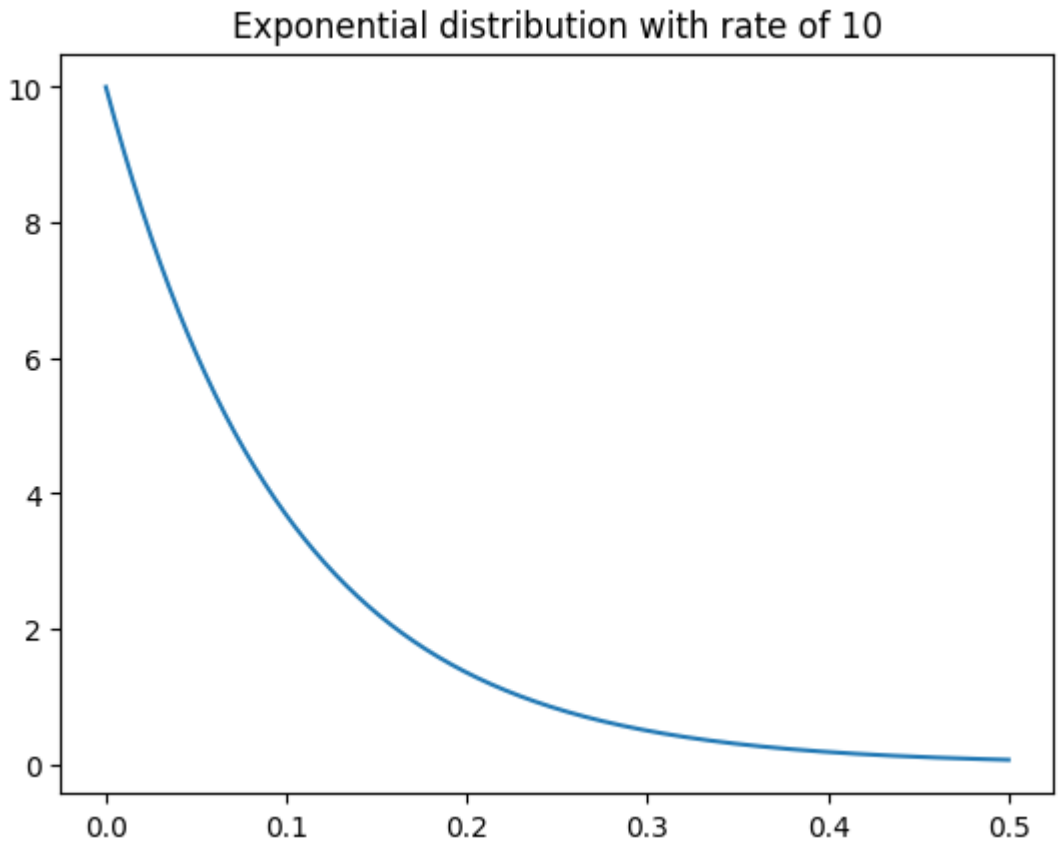


1b. Random intevals

In [5]:
```
from dim_flash import plotflash, randintervals

t = randintervals(10, l=10, t1=1)
plotflash(t, t1=1, t2=2)
```



In [3]:
```
from dim_flash import plot_exponential_distribution

plot_exponential_distribution(10)
```



1c. Seeing the flash

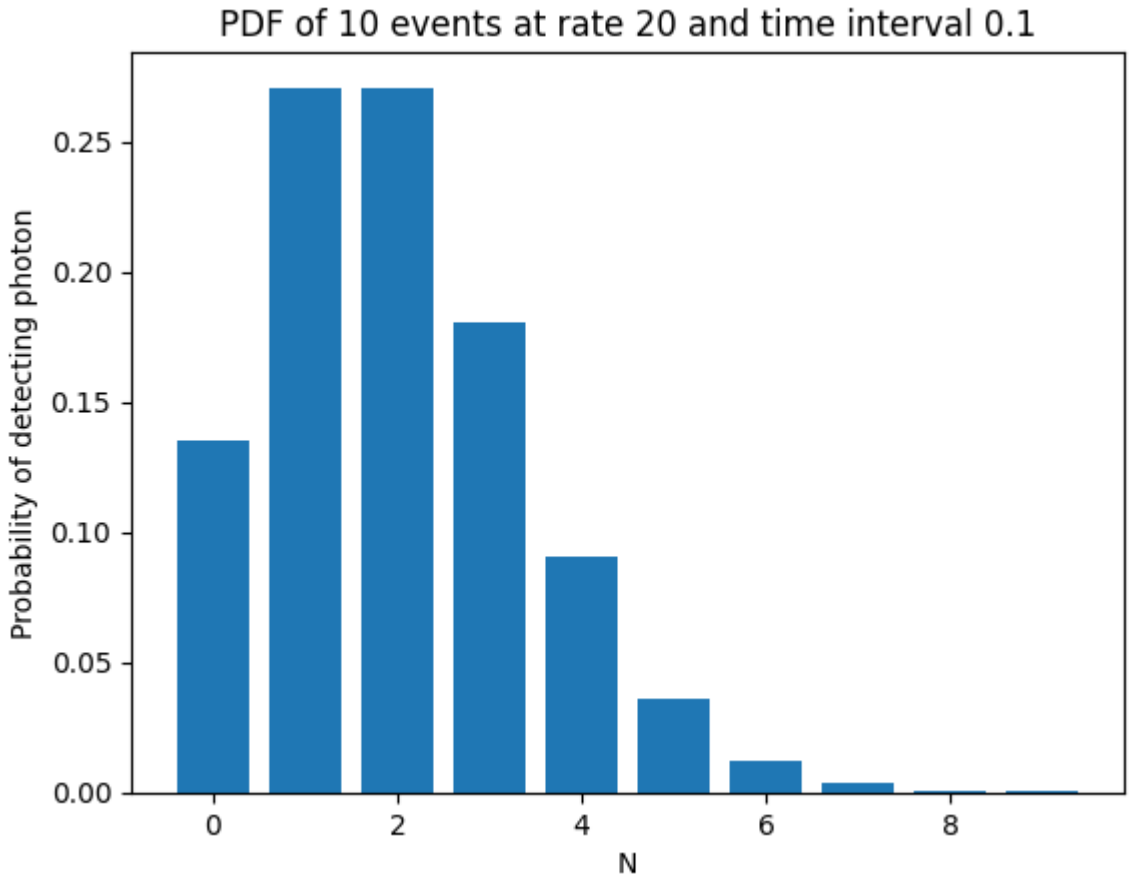
One of the main differences between the two methods above is that in the first calculation of random times, the times are independent of one another. While they are still random the times themselves do not impact each other. This is not the case for the second form of calculation, as it is necessary to take into account the previous time when considering calculation through intervals.

Detecting photons within a certain interval is inherently probabilitic because the stream of photons is inheriently spontaneous. With this randomness, it introduces a probabilistic nature because it can not be completely determined through any existing method.

2. Calculating the probability detection

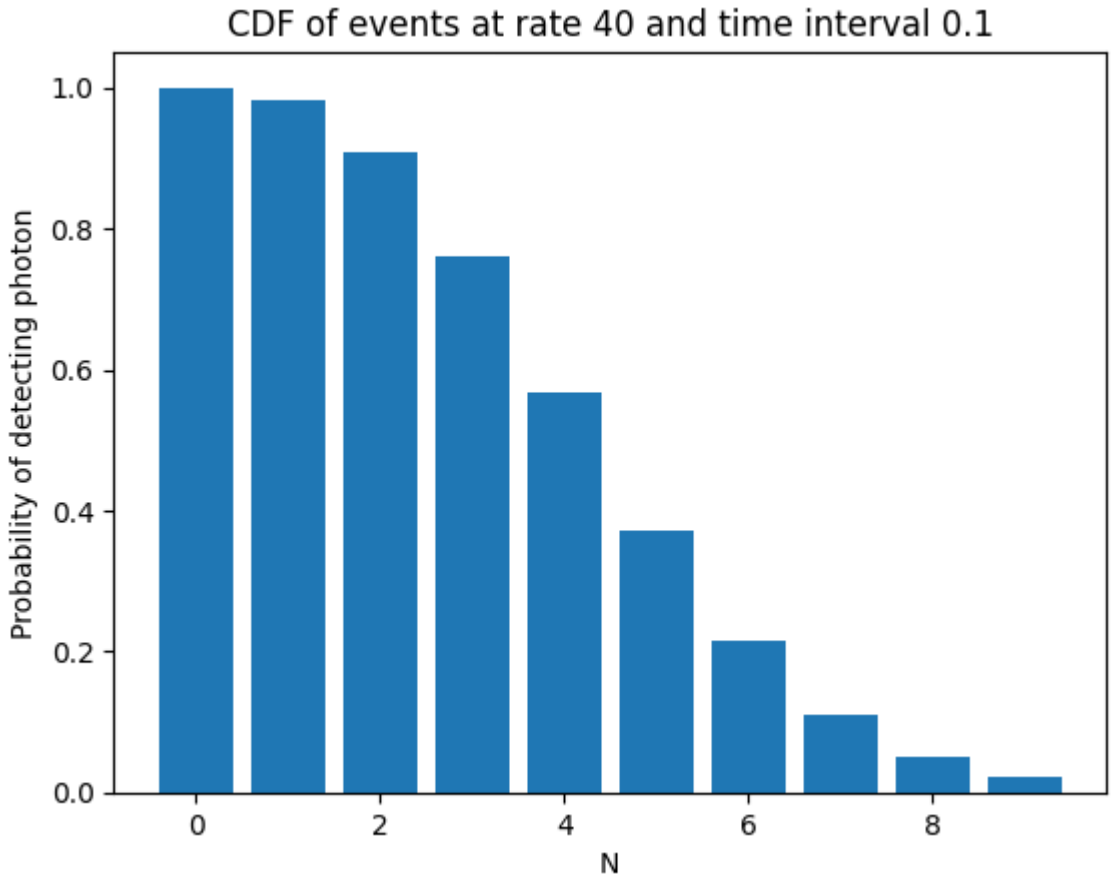
2a. The probability of K photons

In [7]:
```
from dim_flash import poisson_pmf, plot_poisson_pmf

plot_poisson_pmf(10, 20, 0.1)
```



2b. The probability of K or more photons

In [9]:
```
from dim_flash import detectionprob, plotdetectionprob

plotdetectionprob(10)
detectionprob(6, 40, 0.1)
```

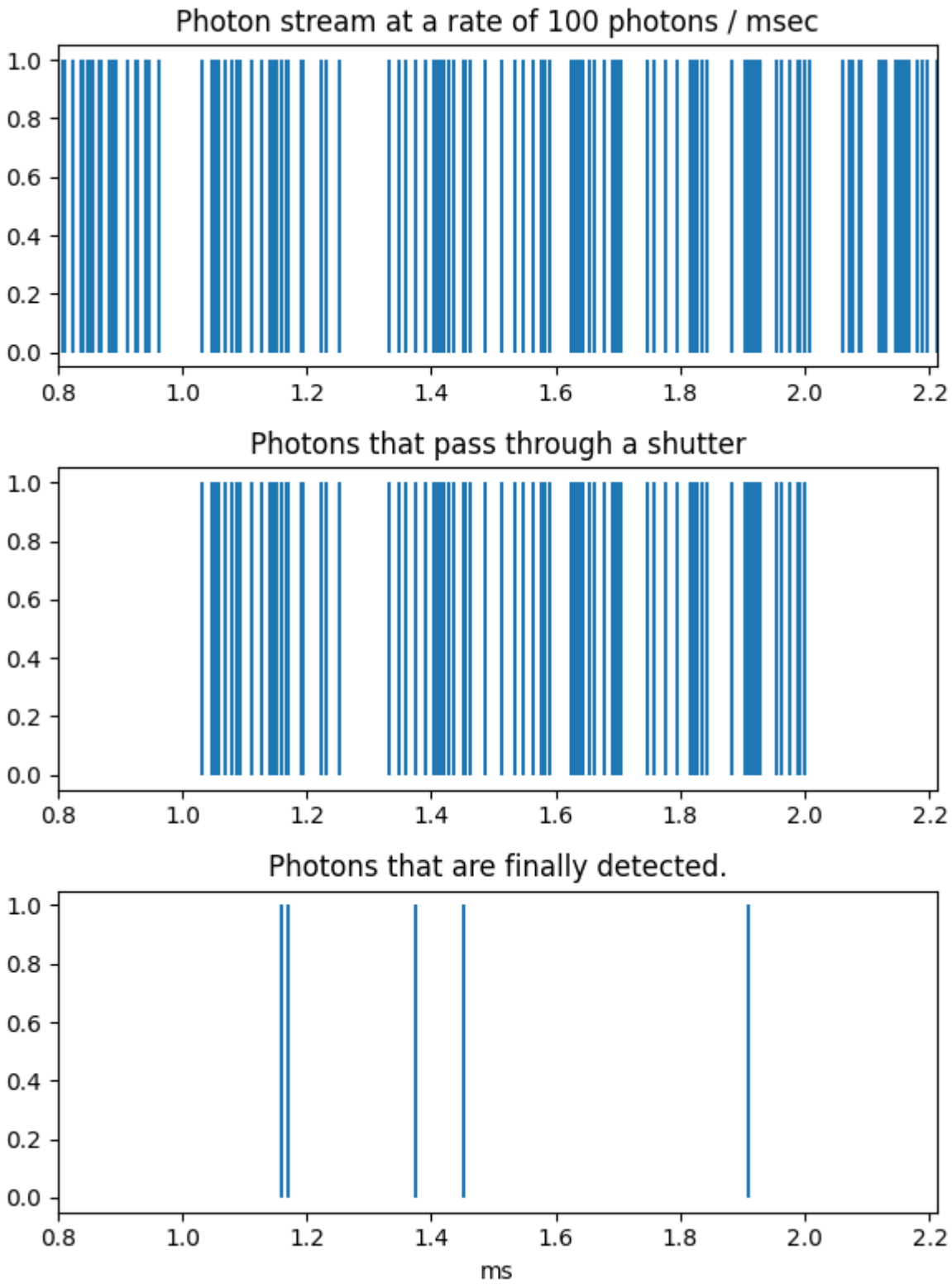


Out[9]: 0.21486961296959495

3. Estimating the threshold from experimental data

3a. Simulating the photon stream

In [9]:
```
from dim_flash import lightflash, plotlightflash

plotlightflash(100)
```



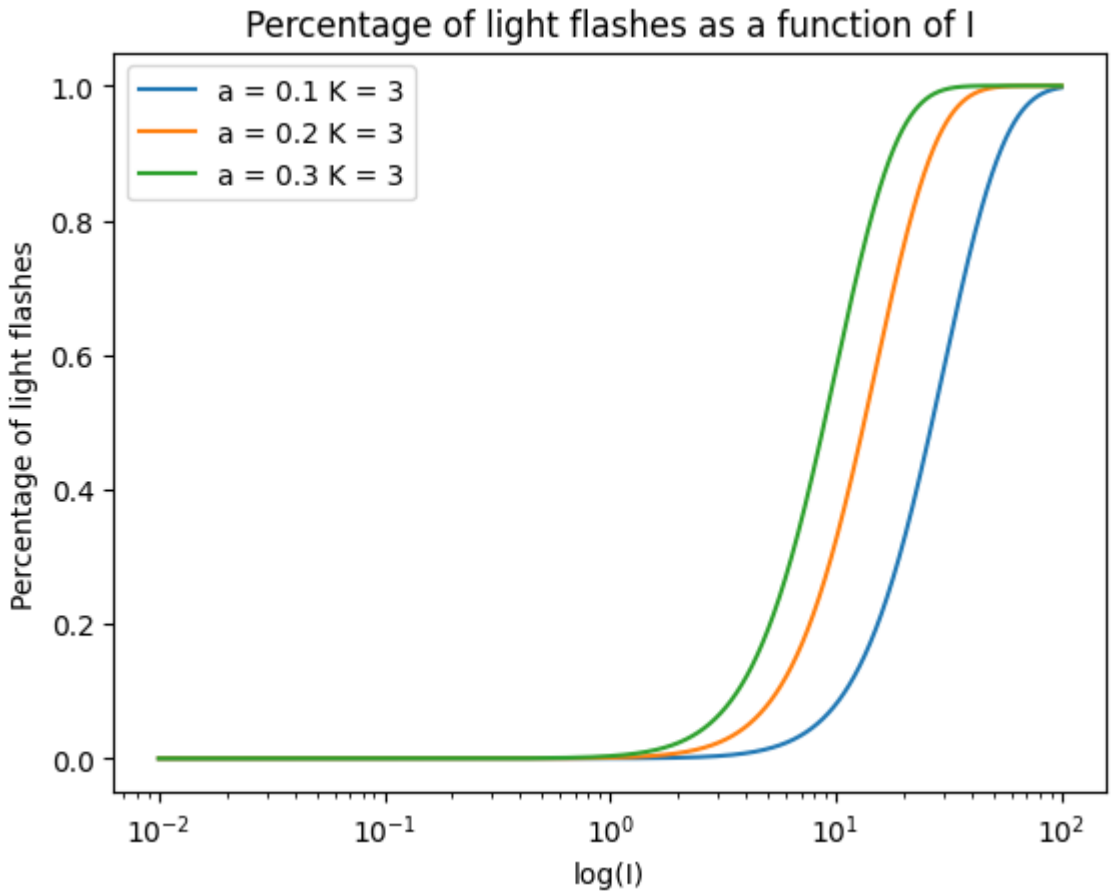
3b. Probability of seeing

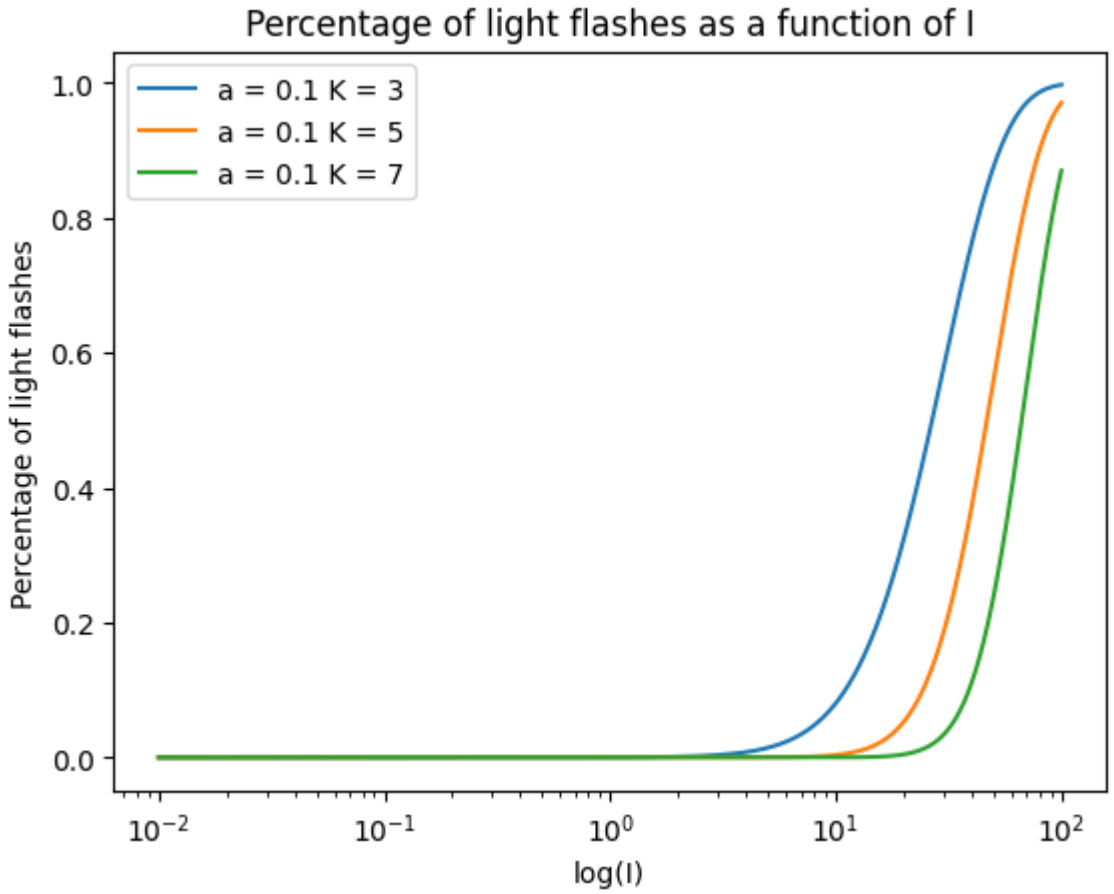
In [10]:
```
from dim_flash import probseeing

probseeing(100)
```

Out[10]:
```
0.5543203586353891
```

3c. Plotting % detected vs light intensity for different parameters

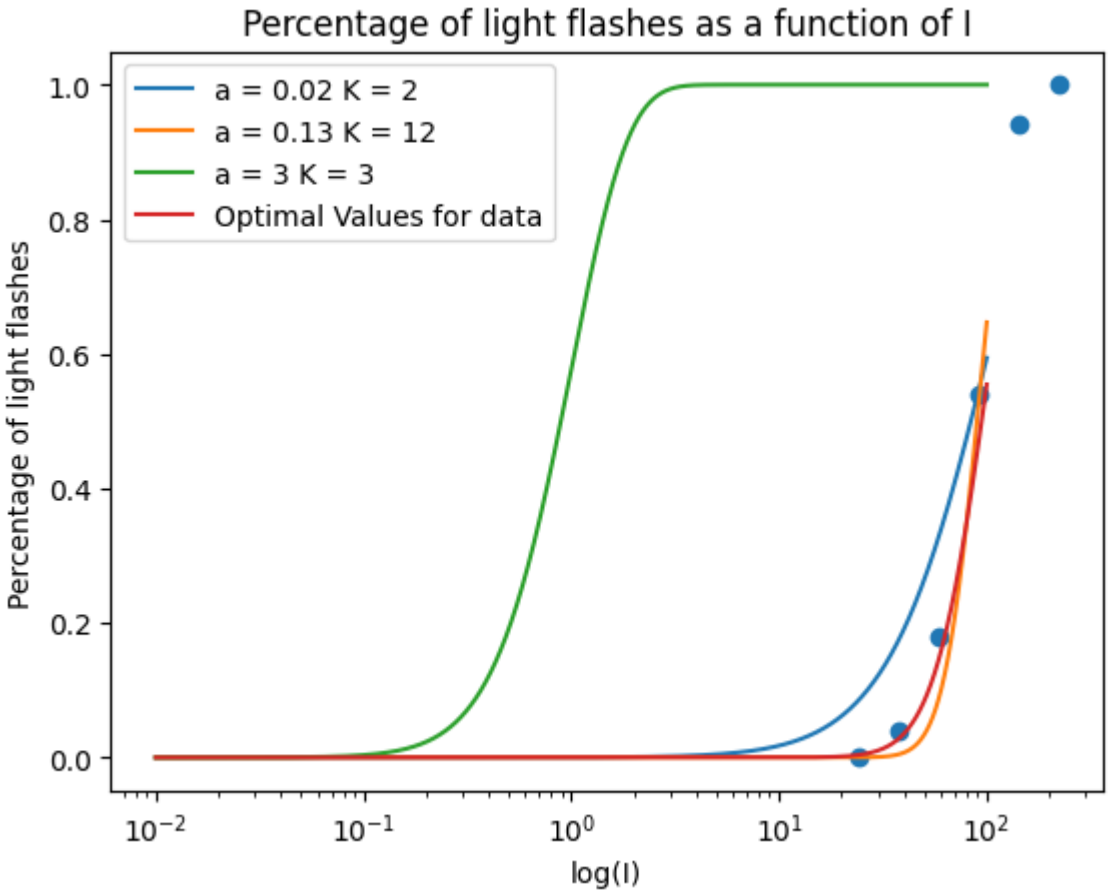
In [11]:
```
from dim_flash import plotdetectioncurve

plotdetectioncurve(a=[0.1, 0.2, 0.3], K=[3, 3, 3])
plotdetectioncurve(a=[0.1, 0.1, 0.1], K = [3, 5, 7])
```





3d. Fitting parameters to experimental data

In [1]:
```
from dim_flash import plotfit

plotfit()
```


Percentage of light flashes as a function of I
a = 0.02 K = 2
a = 0.13 K = 12
a = 3 K = 3
Optimal Values for data
Percentage of light flashes
log(I)
1.0
0.8
0.6
0.4
0.2
0.0
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}