

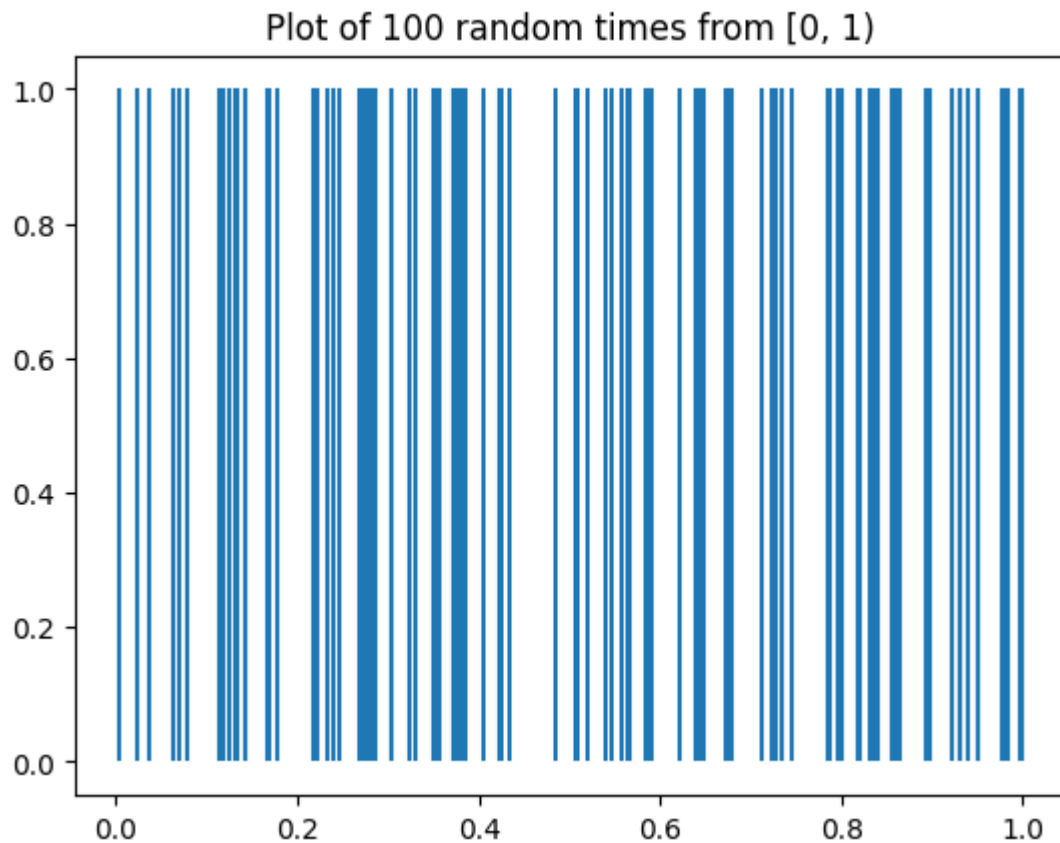
# Assignment A2b: Photon Detection

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## 1. Simulating a dim flash of light

### 1a. Random times

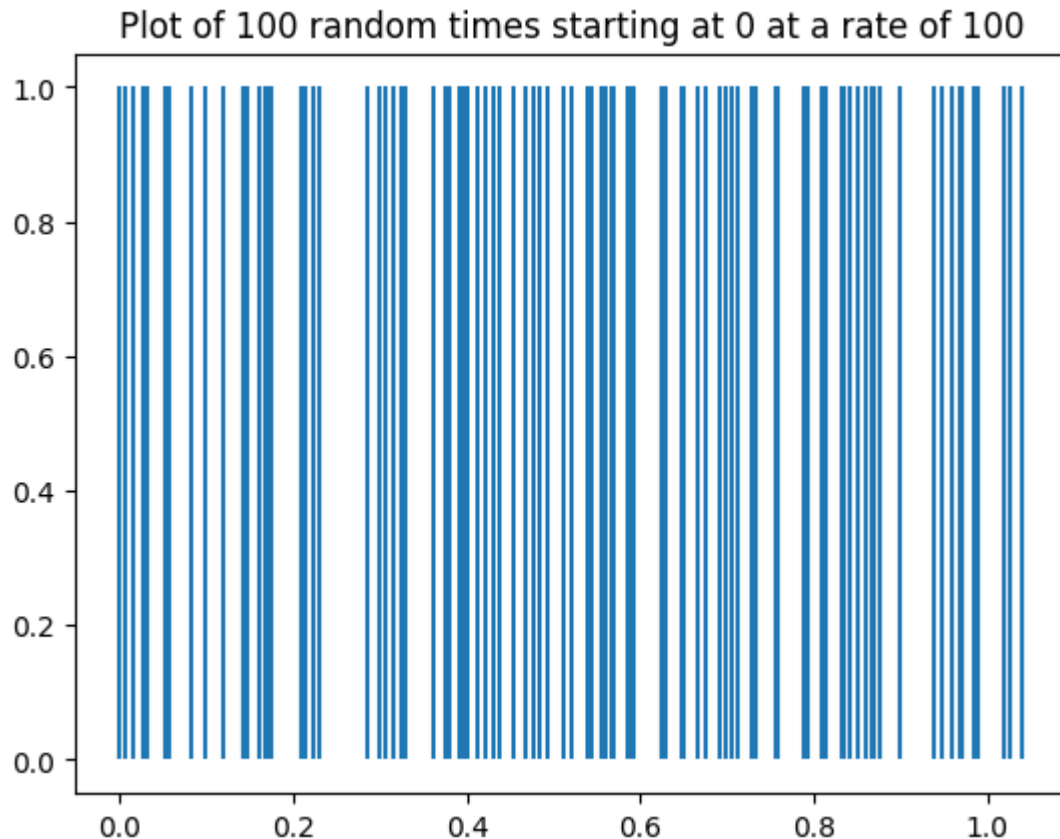
```
In [5]: from dim_flash import plotflash, randtimes  
  
plotflash(100, 0, 1)
```



### 1b. Random intervals

```
In [6]: from dim_flash import plotrandintervals, randintervals  
  
plotrandintervals(100, 100, 0)
```

100 100



### 1c. Seeing the flash

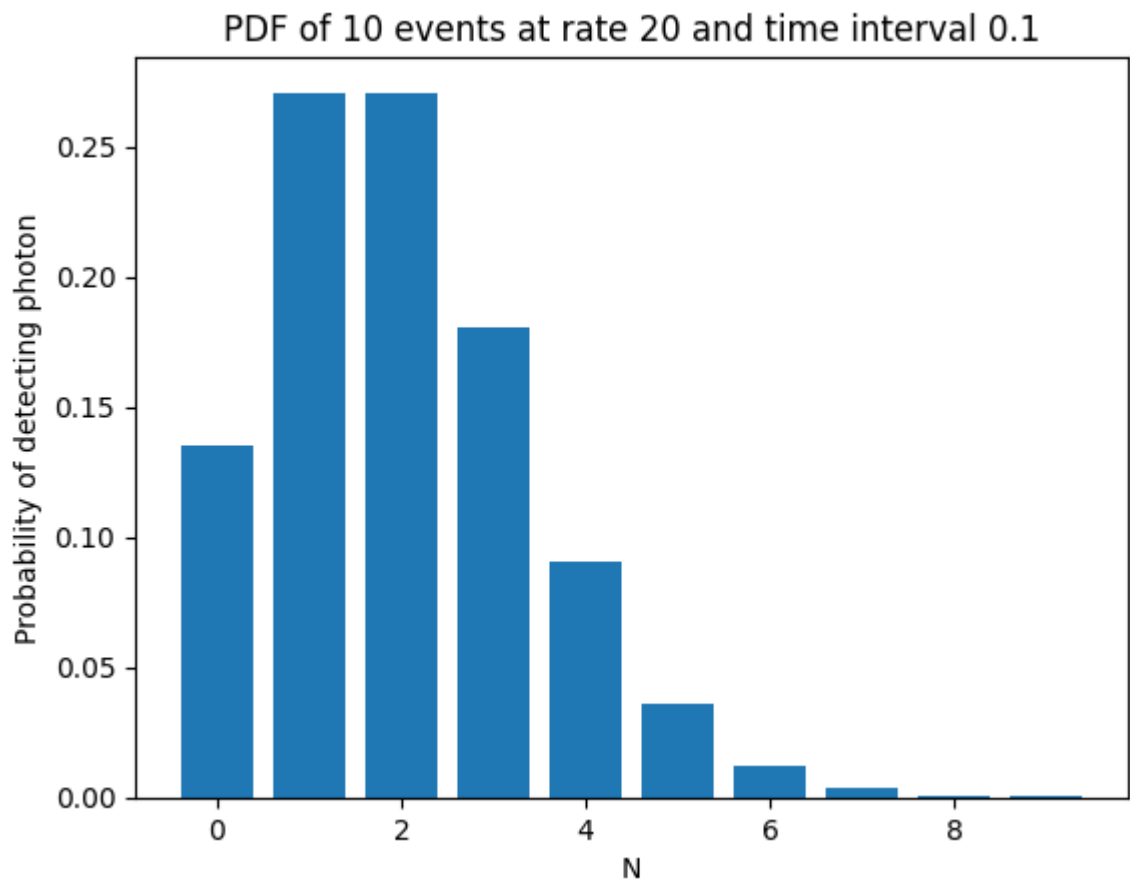
One of the main differences between the two methods above is that in the first calculation of random times, the times are independent of one another. While they are still random the times themselves do not impact each other. This is not the case for the second form of calculation, as it is necessary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

Detecting photons within a certain interval is inherently probabilistic because the stream of photons is inherently 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

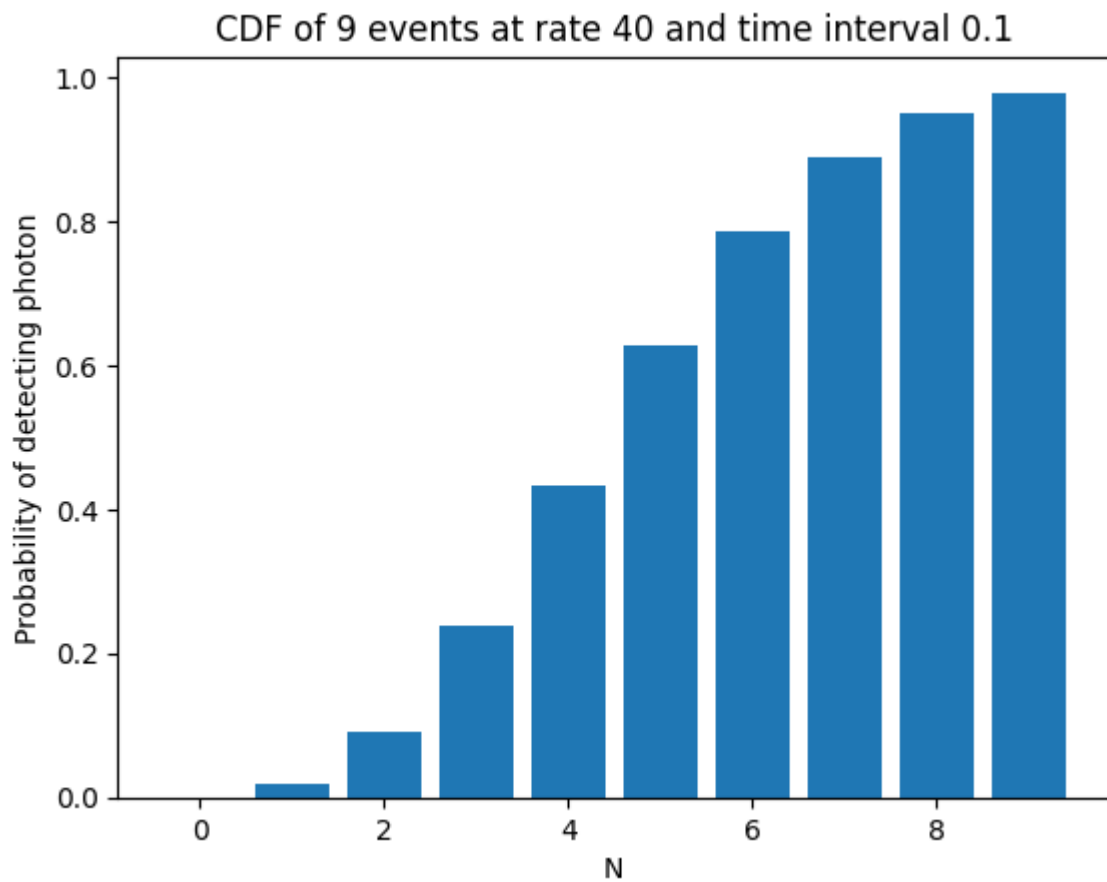
### 2a. The probability of K photons

```
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

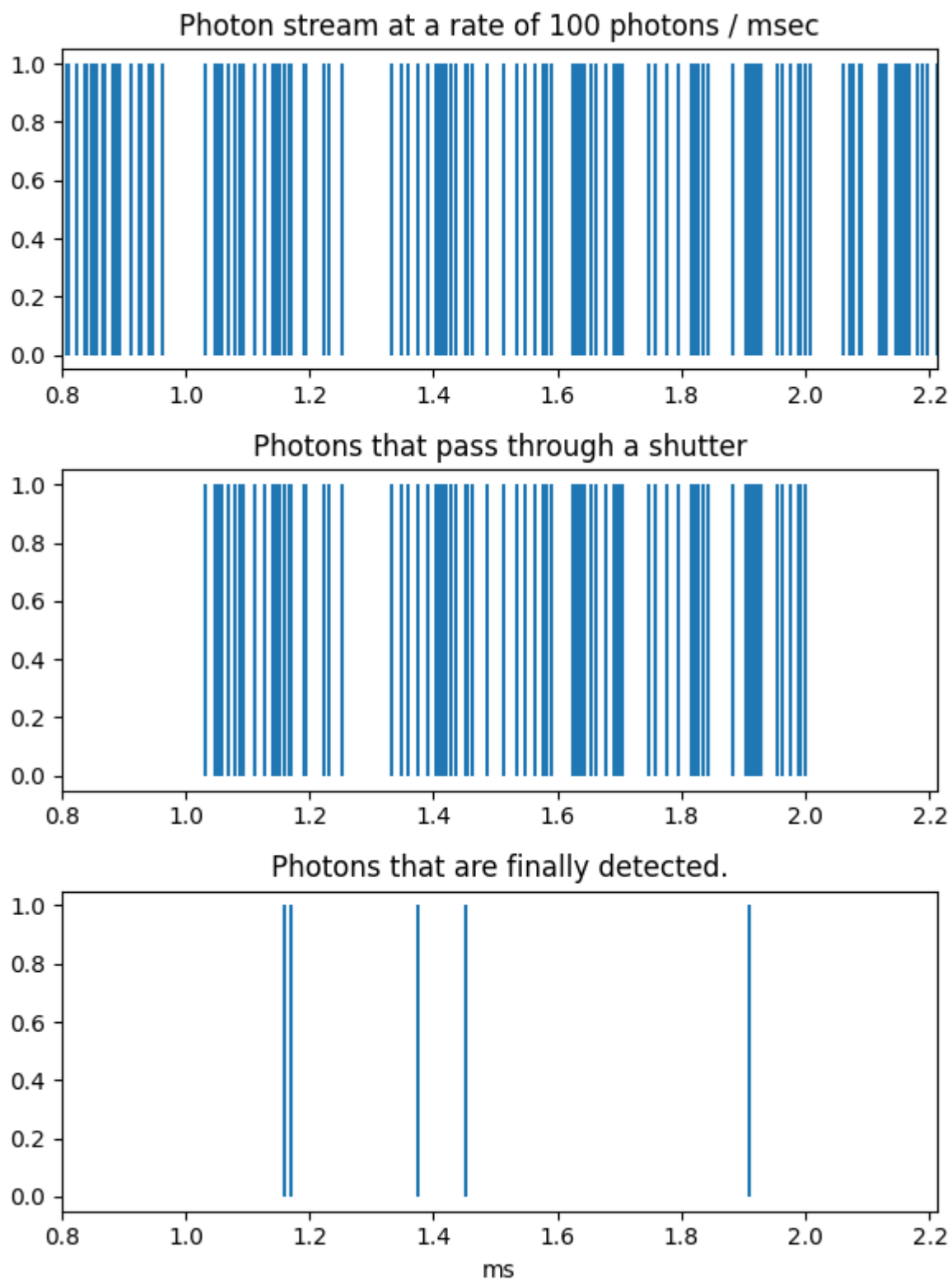
```
In [8]: from dim_flash import detectionprob, plotdetectionprob  
  
plotdetectionprob(10)
```



### 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

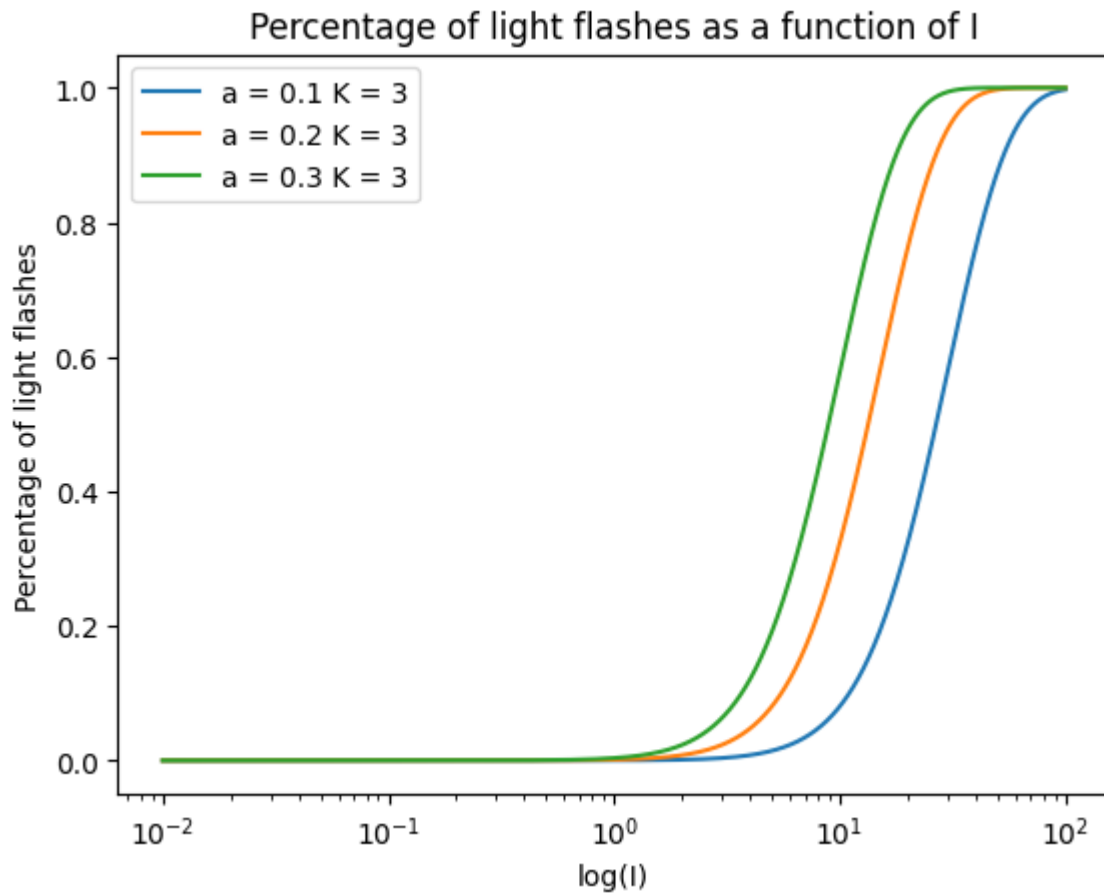
```
In [10]: from dim_flash import probseeing  
         probseeing(100)
```

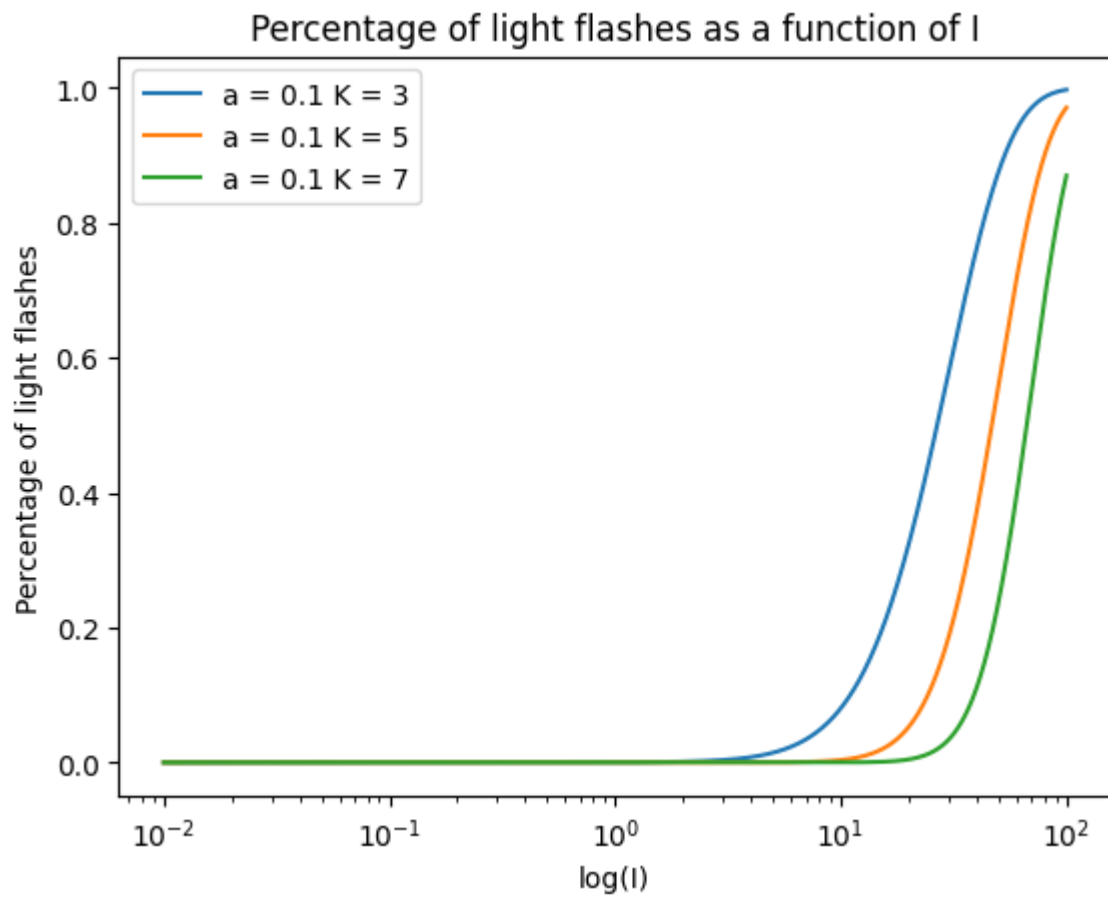
Out[10]: 0.5543203586353891

### 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 [12]: from dim_flash import plotfit  
  
plotfit()
```

Percentage of light flashes as a function of  $I$

