PHY408 Lab One: Computational Python

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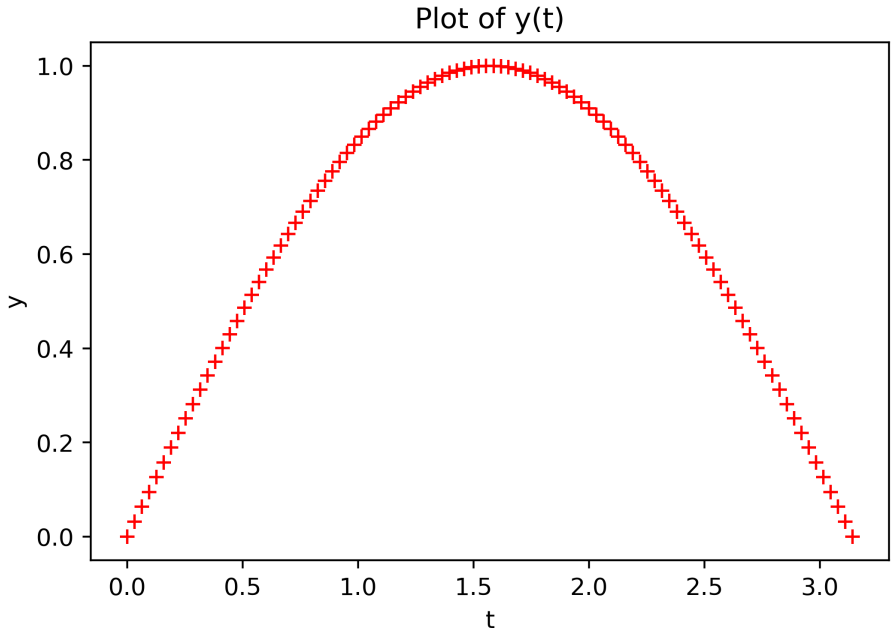
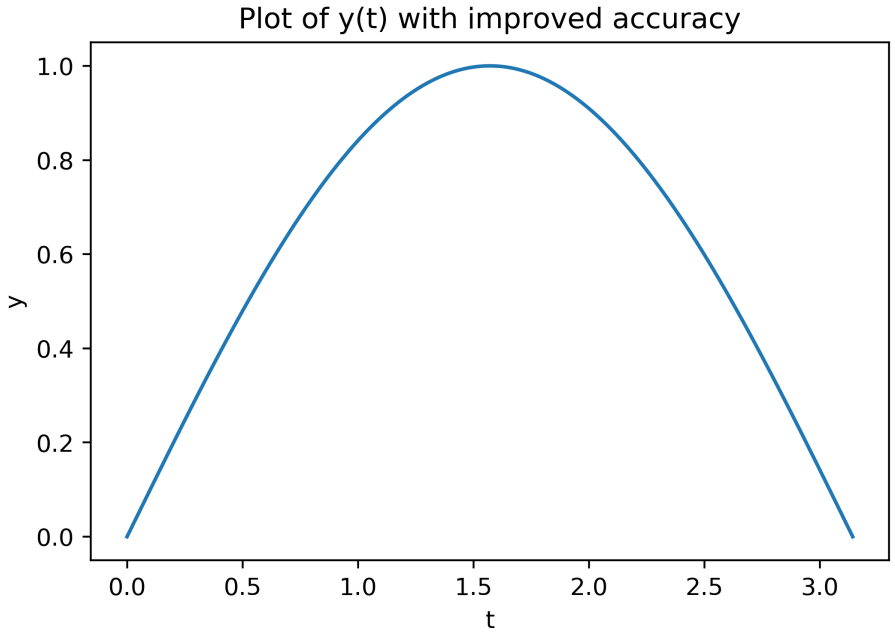
Part One

Collaborators: None.

The plot of $y(t)$ is below:



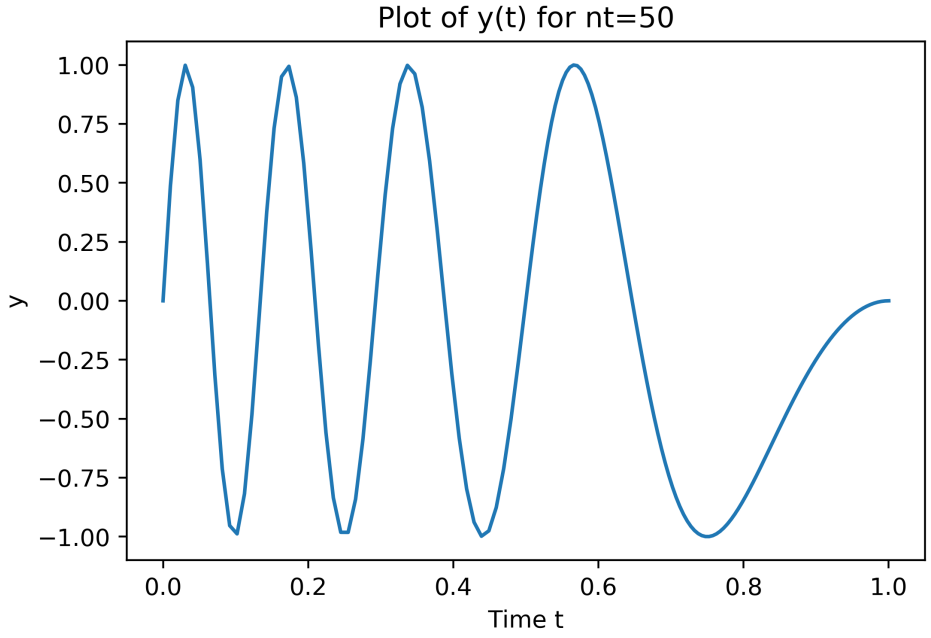
The output of c is: 1.9998321638939935. It is quite close to the result we expect: $\int_0^{\pi} \sin(t)dt = 2$. We can improve this result by increasing the number of samples nt. If we increase it to 1000, the result becomes 1.9999983517708535, which is even closer to 2. The improved plot is quite similar to the first plot. It is shown below:



Part Two

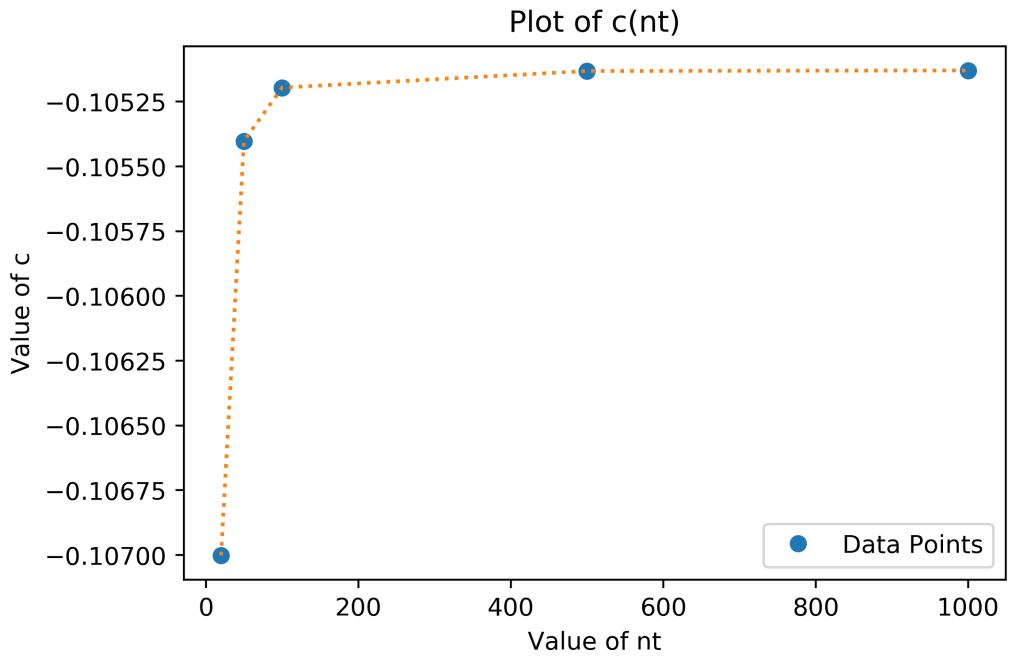
Collaborators: None.

The plot of $y(t)$ for $nt = 50$ is shown below:



As we increase the value for nt, the integral results converge to the approximate value of -0.105128938. As we can see, for $nt = 20, 50, 100, 500, 1000$, the computed results from python are approximately

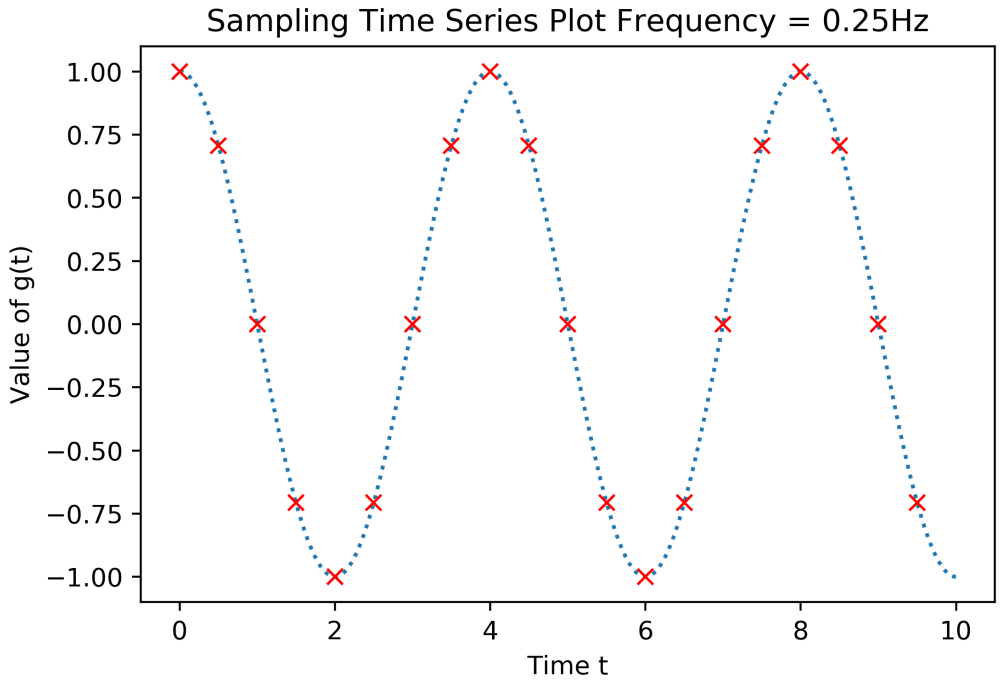
$c = -0.107001771, -0.105402136, -0.105195684, -0.105131566, -0.105129594$, which are closer and closer to the theoretical value.

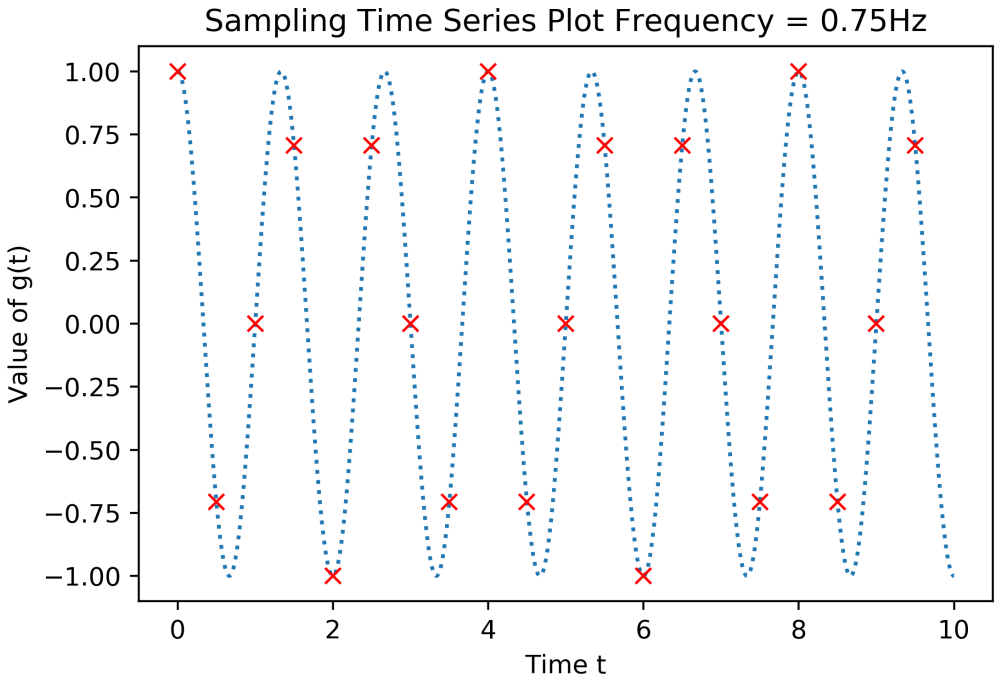


Part Three: Accuracy of Sampling

Collaborators: None.

The plots for $0.25Hz$ and $0.75Hz$ are shown below:





The apparent frequency for $f = 0.25$ and $f = 0.75$ is 0.25. For $f = 0.5$ and $f = 1.5$ is 0.5. $f = 1.0$ the apparent frequency is 1 and when $f = 0$ and $f = 2$ the apparent frequency is 0 since the time series is flat.

For a sampling interval of $dt = 0.5$, when frequency $f = 0.25$, 0.75 and 0.5, we can clearly see a curve pattern from the red crosses, which fit the original time series quite reasonably. Therefore, the sampling time series is a fair representation. For frequency $f = 0$, the points form a straight line, so the value of g is stationary and independent of time, which also fits the original time series $g(t)$, so it is also a fair representation. However, for frequency $f = 1.0$,1.5 and 2.0, although the points show a pattern over time t, the red crosses do not somewhat capture the original time series, so the sampling time series is not a fair representation. A reasonable guess for the maximum frequency f of $g(t)$ such that it can be fairly represented by the discrete time series is approximately $f = 0.75$. Any frequency higher the discrete time series will not quite represent the original time series $g(t)$ well enough.