Introduction to Computational Physics
Excersices

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please note the naming pattern of source files:
excercise X task Y [part Z [a...z]] = `eXtY[pZ[a...z].cpp`

1 Task 1

see `e1t1p1.cpp` (using $n = 100000$; $c = 3$; $p = 31$; $x_{\text{seed}} = 1$)

1.1 Square test

Correlation / square test plot: see fig 1

1.2 3d plot for cube test

Cube test plot: fig. 2 and `e1t1p2.cpp` (using $n = 100000$; $c = 3$; $p = 31$; $x_{\text{seed}} = 1$)

(created with matlab: `plot3(rnd3d(:,1),rnd3d(:,2),rnd3d(:,3),'.')` and using gui)

1.3 Other RNG's

See `e1t1p3a.cpp` for fig 3 and `e1t1p3b.cpp` for fig 4 (using $n = 10000$; $c = 5648$; $p = 34875$; $x_{\text{seed}} = 8451$)

2 Task 2

See `e1t2.cpp` and plot 5 (using $n = 10000$; $c = 16807$; $p = 2147483647$; $x_{\text{seed}} = 1$) Skech of idea, using cartesian coordinate system and unit circle:

- generate a pair of homogeneous random points (x_1, x_2), with $x_i \in [-1, 1]$
- if $x_1^2 + x_2^2 <= 1$, then return the point, otherwise reject it and try again
- if necessairy, transform (x_1, x_2) to polar coordinate system (r, ρ)

3 Task 3

See `e1t3.cpp`, used $k = 10$ bins, $n = 1000$ binned random numbers ($np_i = 100$).

- $c = 3$; $p = 31$; $x_{\text{seed}} = 1$: $\chi^2 = 0.1$
- $c = 1017$; $p = 8191$; $x_{\text{seed}} = 154$: $\chi^2 = 5.54$

- built in `rand()` (using init. `srand(670706)`) $\chi^2 = 13.74$

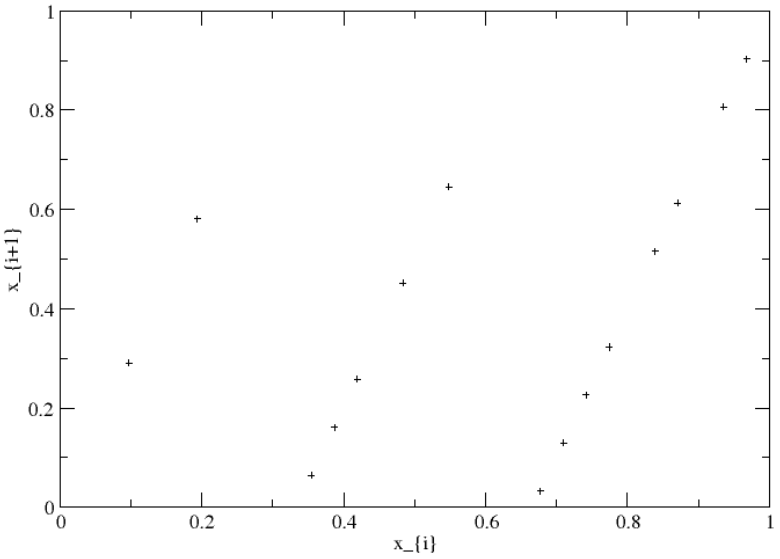

Figure 1: Square test plot for first set of values

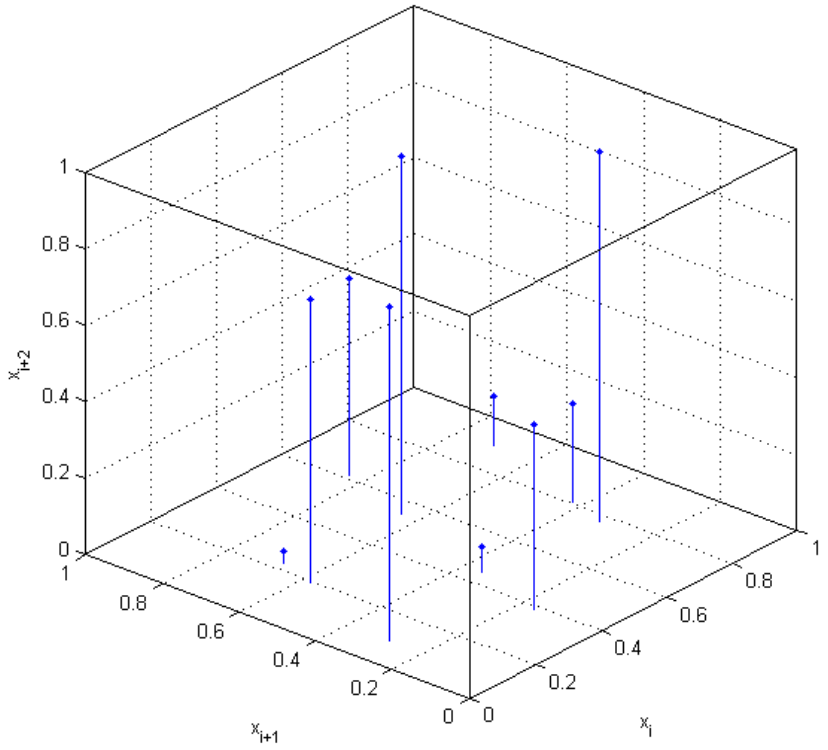

Figure 2: Cube test plot for first set of RNG values

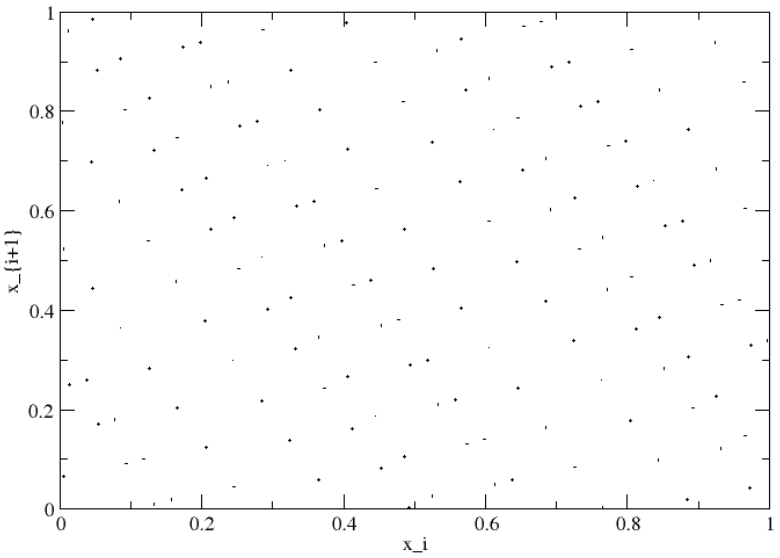

Figure 3: Squareplot with second set of RNG values

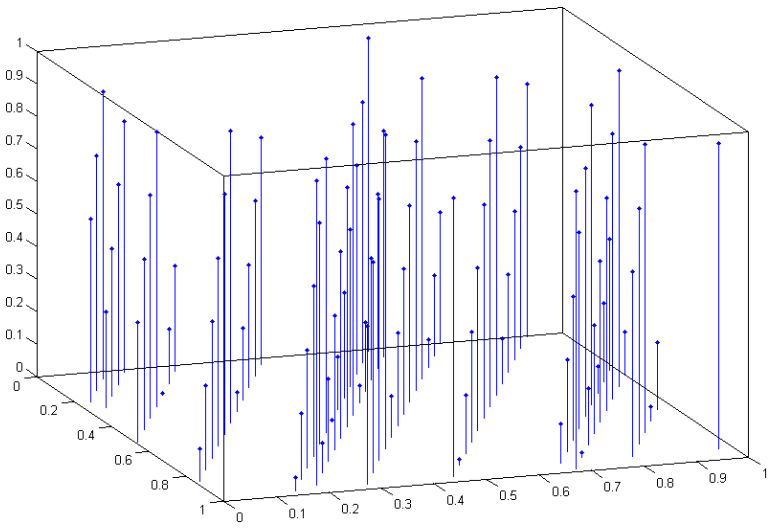

Figure 4: Cubeplot with second set of RNG values

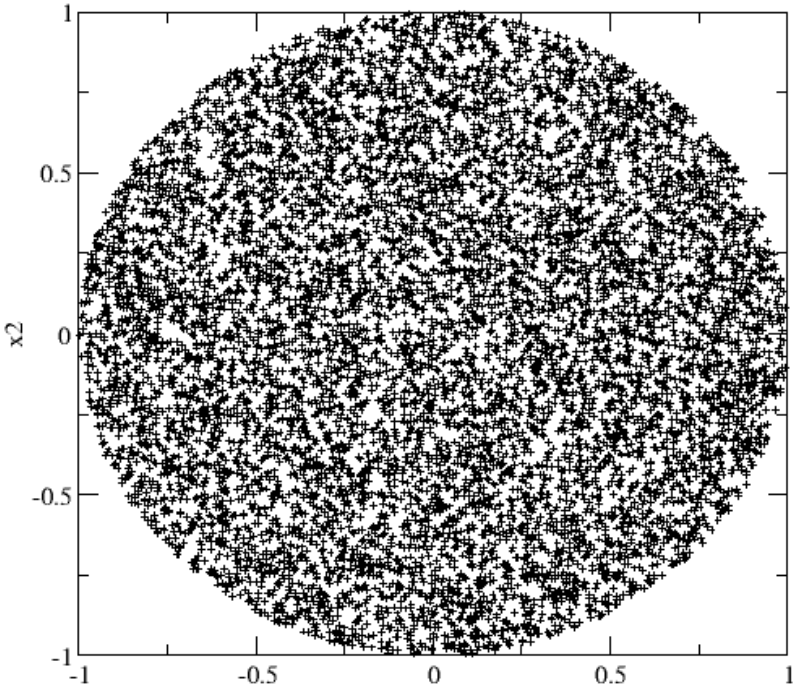

Figure 5: Random numbers in a circle