3 − FINITE DIFFERENCE METHODS

```
Off[General::spell]
<< Graphics`MultipleListPlot`
```

Initialization

```
xmin = -1;
xmax = 1;
dx = 0.04;
Npoints = Floor[(xmax - xmin) / dx + 1];
alpha = 1.0;
beta = 8.0;
a = 1.0;
CFL = 0.8;
dt = CFL * dx / Abs[a];
Ntimes = 1250;
```
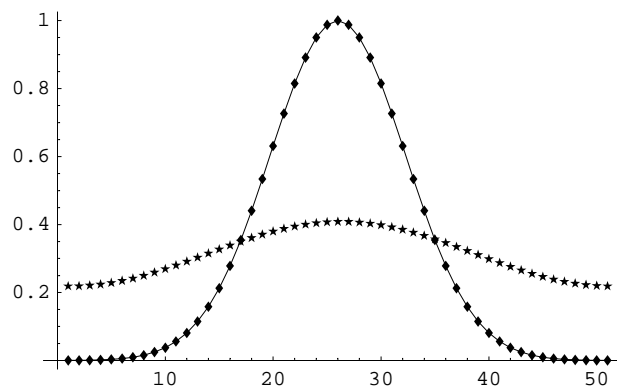
Gaussian Pulse Initial Data

```
x = Table[xmin + (i - 1) * dx, {i, 1, Npoints}];
ui = Table[N[alpha * Exp[-beta * x[[i]] ^ 2], 16], {i, 1, Npoints}];
u = Table[Null, {i, 1, Npoints}];
un = Table[Null, {i, 1, Npoints}];
```

1st-Order FTBS (Courant-Isaacson-Rees)

```
Do[u[[i]] = ui[[i]], {i, 1, Npoints}]

Do[
 un[[1]] = u[[1]] - a * (dt / dx) * (u[[1]] - u[[Npoints - 1]]);
 Do[
   un[[i]] = u[[i]] - a * (dt / dx) * (u[[i]] - u[[i - 1]])
   , {i, 2, Npoints}]
  Do[
   u[[i]] = un[[i]]
   , {i, 1, Npoints}]
 , {j, 1, Ntimes}]
```

MultipleListPlot[ui, u, PlotJoined → {True, False}]

- Graphics **-**

1st-Order Lax-Friedrichs

2nd-Order Lax-Wendroff (1-step)

2nd-Order Richtmeyer-Morton (2-step)

2nd-Order MacCormack (2-step)