# On-line Mathematical Utilities for Java Enabled Devices

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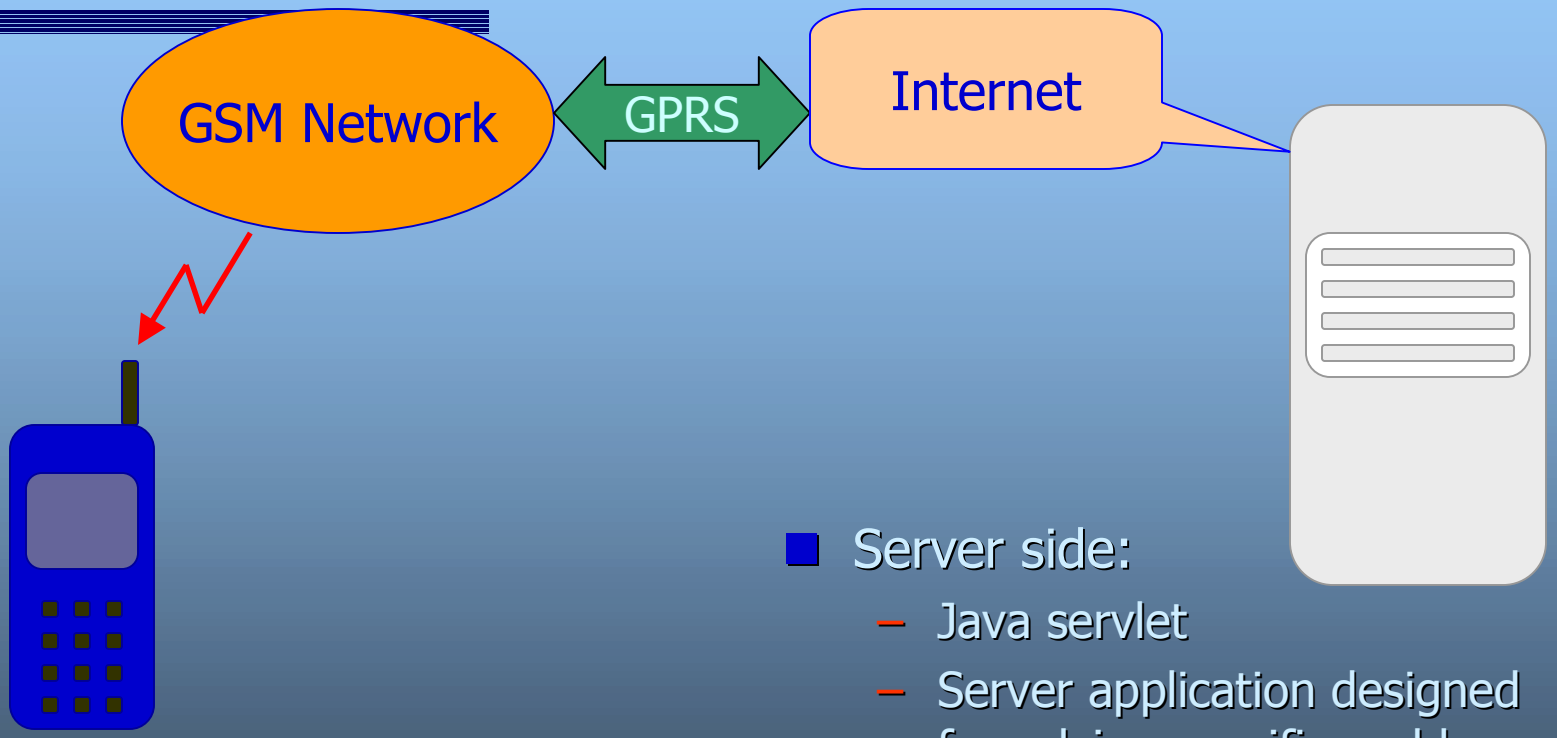
# Outline

- Applications for solving computationally demanding scientific and engineering problems on powerful servers using Java enabled mobile devices as terminal equipment.

**Motivation:**

- To provide fast and accurate numerical solution to complex and computationally demanding engineering problems "on site", without need to take the job to the laboratory
- To enable mobile users to access powerful servers (including parallel computers) using small, light and affordable terminal equipment like GSM phones

# Realization

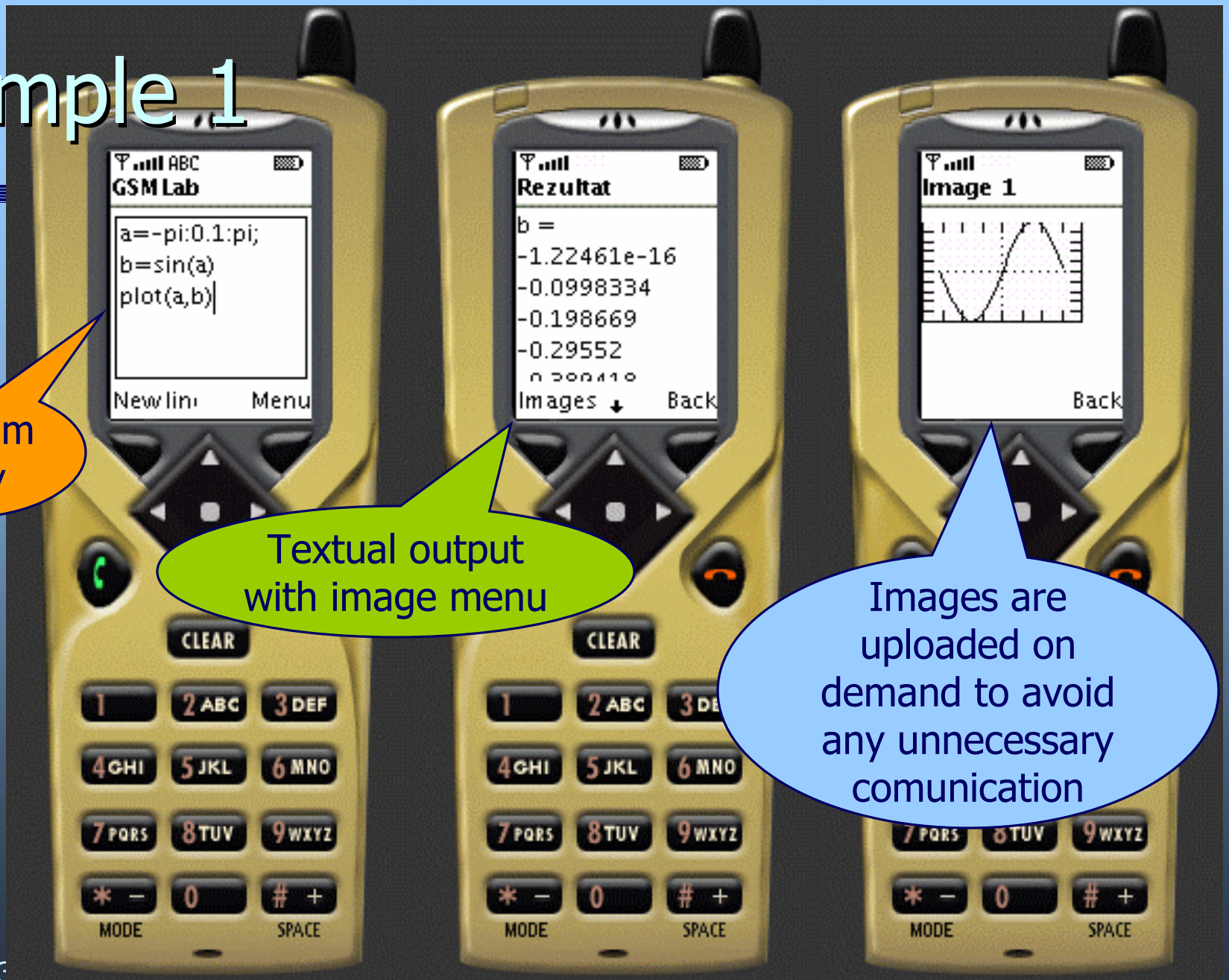



- Client side: Java enabled GSM device
- Server side:
  - Java servlet
  - Server application designed for solving specific problem
  - Octave (Matlab) – numerical computation
  - Gnuplot - images

# GSMLab

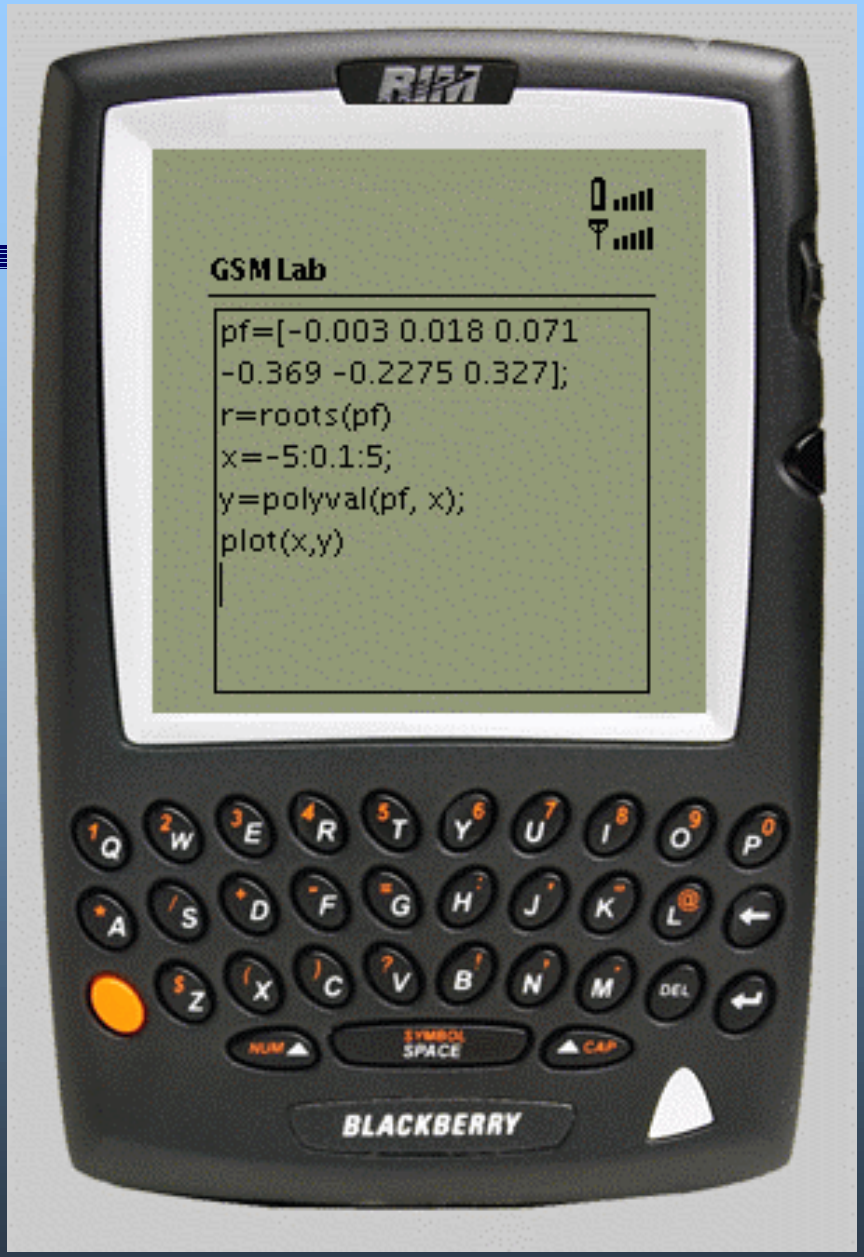
- Interface for **GNU Octave**:
  - High level language primarily intended for numerical computations
  - High compatibility with matlab, which is de facto standard in scientific and engineering calculations
- Tool for wide range of engineering problems, not limited to a set of problems specific software can solve
- Graphical representation of numerical results
- User must know Octave (Matlab) syntax

# Example 1


GSM Lab
a=-pi:0.1:pi;
b=sin(a)
plot(a,b)
Menu
Rezultat
b =
-1.22461e-16
-0.0998334
-0.198669
-0.29552
Images
Back
Image 1
Back
Program entry
Textual output with image menu
Images are uploaded on demand to avoid any unnecessary comunication


# Example 1,cnt.

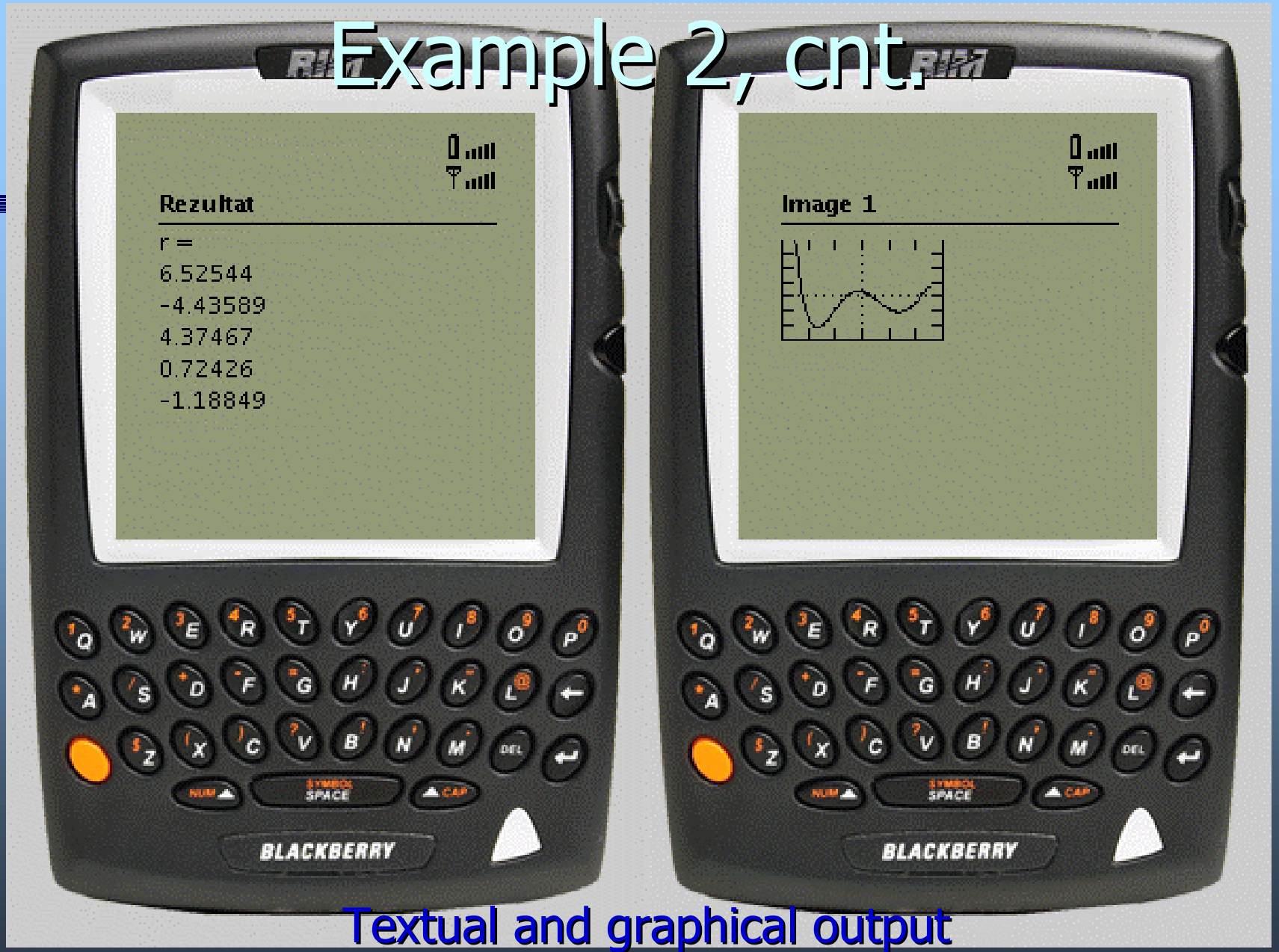
- Same example on device with big screen:
  - Textual output is more readable
  - Graphical output plays important role in representation of numerical results, especially on devices with small display!!!




# Example 2

- Finding the roots of the polynomial
  - Image 1: User program for finding the roots of the polynomial
  - Coefficients of the polynomial are elements of the vector, roots are calculated numerically
  - At the end of the program typical code for drawing function

# Example 2, cnt.




Textual and graphical output

# GSMPlot

- Interface for **Gnuplot**, draws five different types of functions
  - User can set variable ranges (to examine function on specific interval), or use default values
  - Devices with color display are detected and images are plotted in color – helpful in 3D
- Different approach
  - Service is limited to a specific problem
  - User is provided with easy-to-use interface and graphical output, with no need for any deeper knowledge of tools used
  - This is good example of how different services for specific problems could be developed based on this technology

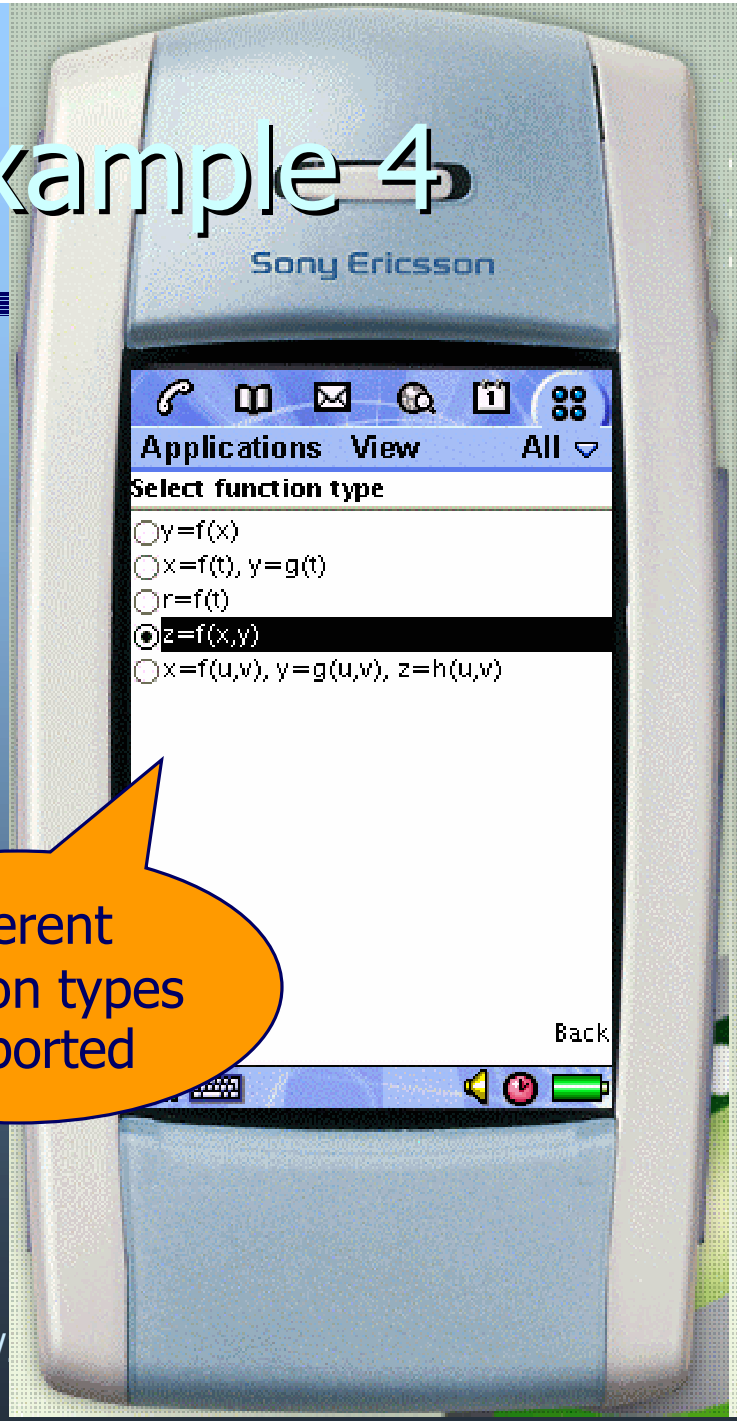
# Example 3

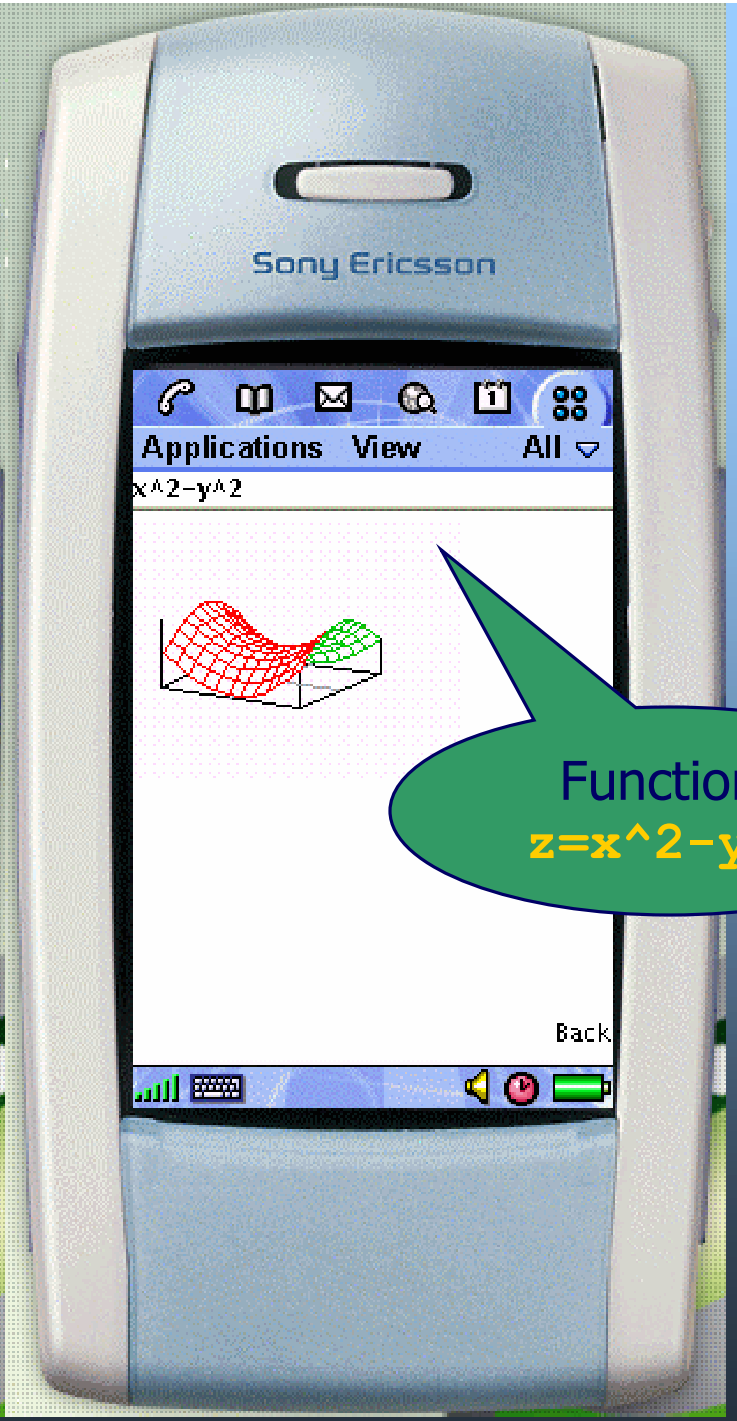
Function type:
`y=f(x)`

Function to plot:
`sin(x)/x`


Output

# Example 4



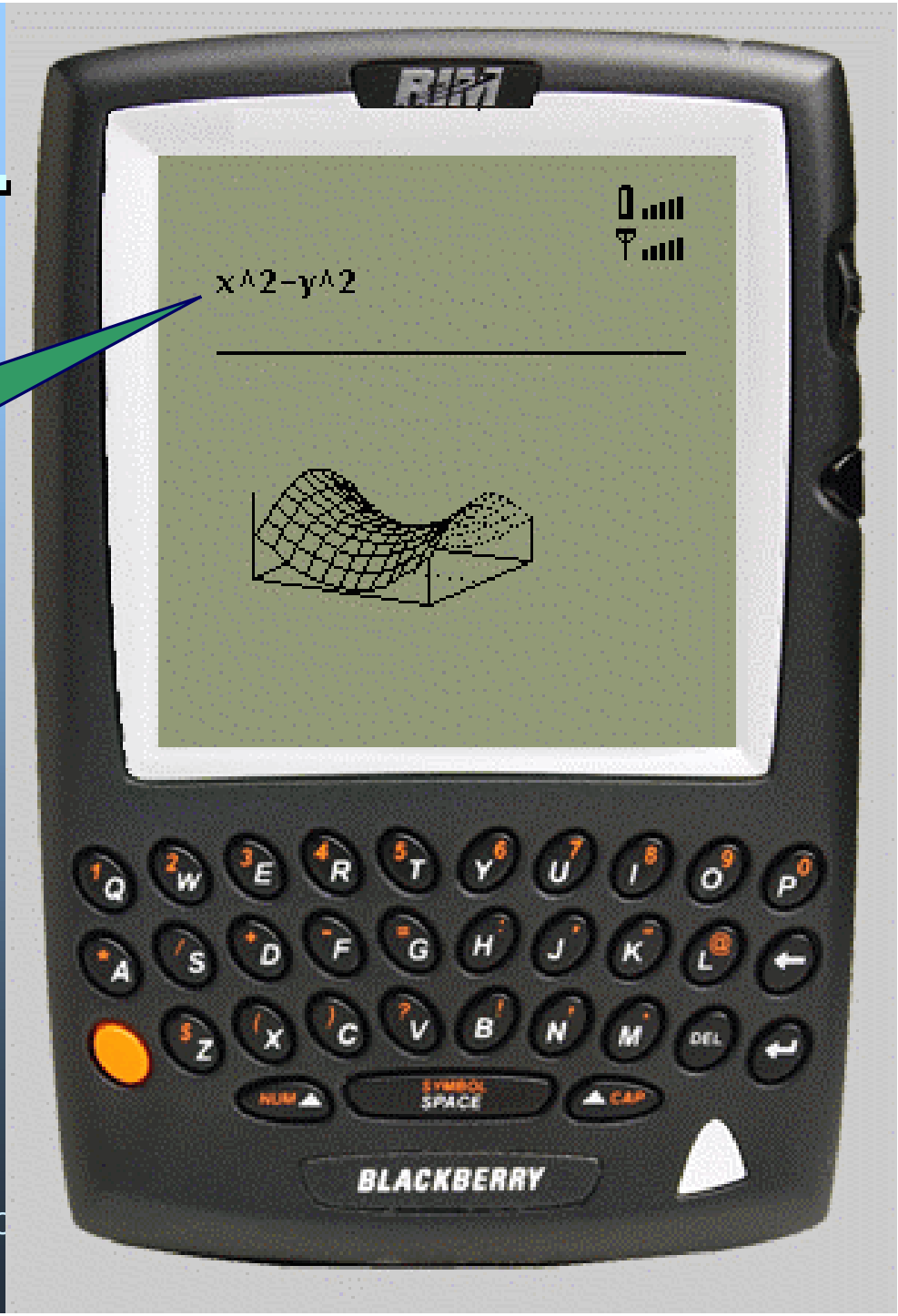

Diferent function types supported

Function: z=x^2-y^2

# Example 4, cnt.

Function is always shown on the top of the screen

Same example on another device



# Example 5


3D parametric function | Ranges | Image

# Example 5, cnt.

- Same example on device with color display:
  - Color screen is detected and image is plotted in color. This is helpful to gain perspective for the 3D images

# Security issues

- GSMLab: User is provided with fully functional programming language and can write programs which are executed on server side!!!
- Three levels of security:
  1. User input is filtered and execution is blocked if any suspicious command is detected
  2. Server is started in `chroot-ed` environment (user can see only subtree of the main application directory)
  3. System resources (max. Execution time, memory, number of processes, etc.) are limited

# Future work

- User authentication and access logging
  - Possible commercial implementation
  - Additional security
- Storage space (on server) for frequently used programs could be provided for authorized users
- Configuration
  - Automatic, by detecting device type
  - Manual, according to user preferences
- Development of new services based on this technology.

# Download

- Client for the GSM device can be downloaded from:

***http://lolek.csc.unist.hr/MathGSM/MathGSM.wml***

- By following the link on this page, Java client for GSM device will be installed on the device.

Device should be properly configured for Internet access