

MAT 7003 : Mathematical Foundations

(for Software Engineering)

J Paul Gibson, A207

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<http://www-public.it-sudparis.eu/~gibson/Teaching/MAT7003/>

Introduction

<http://www-public.it-sudparis.eu/~gibson/Teaching/MAT7003/L0-Introduction.pdf>

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T&MSP: *Mathematical Foundations*

MAT7003/Intro.1

FROM MODULE DESCRIPTION

Objectives: Engineering is a bridge between science and mathematics, and the technological needs of mankind. Engineering disciplines are fundamentally mathematical and problem solving based. Traditional engineering disciplines, such as chemical, civil, electrical and mechanical, rely heavily upon continuous rather than discrete mathematical foundations. Software engineering is an emerging discipline that applies mathematical and computer science principles to the development and maintenance of software systems. It relies primarily upon principles of discrete mathematics, especially logic.

Skills: Capacity to use mathematical reasoning to derive, understand and debug software systems. With sufficient practice, the underlying mathematical concepts become intrinsic to the thought processes, supporting rather than hindering thinking.

Pre-requisites: None

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MAT7003/Intro.2

Some Information About Me

<http://www-public.it-sudparis.eu/~gibson/>

Now, what about you ..?

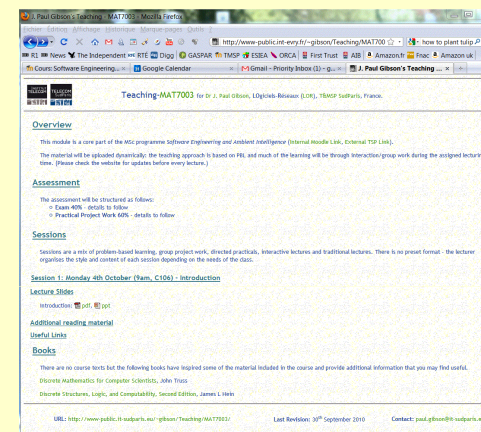
Mlle	ANDREESCU	Oana Fabiana
Mr	FERNANDEZ	Rolando
Mr	LASISI	Saheed Abiola
Mme	OZAYGEN	Hande
Mr	PERUMAL	Ravindran
Mr	TULVAN	Daniel-Andrei

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MAT7003/Intro.3

Web Site On My Local Pages – open access



TO DO:
Check that you can
access this page

Please note that - to access internet from C106- you may need to set the proxy server for your web browser to proxy.int-evry.fr and port 81.

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MAT7003/Intro.4

Web Site On TMSP Moodle Pages

TO DO:
Check that
you can
access this
page

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MAT7003/Intro.5

TO DO: Complete Initial Questionnaire

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MAT7003/Intro.6

TO DO: Complete Test

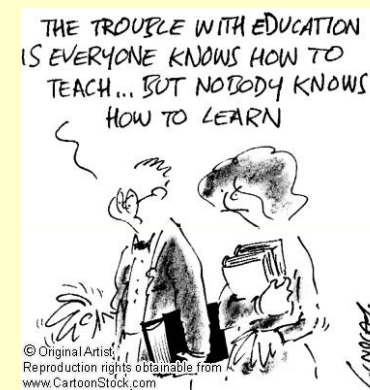
This will be provided at class

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Some Information About *Problem Based Learning*



TO DO:

Find and read some
background material on
the web about PBL

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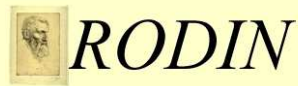
MAT7003/Intro.8

RODIN – A tool for formal software development

We will use it in most of our mathematical problems

Its good that you know how to install it yourself

It runs on Eclipse ... which runs on "any" OS



Rigorous Open Development Environment for Complex Systems

INSTALLING RODIN - <http://www.event-b.org/>

Session 1: Monday 4th October (9am, C106) - Introduction

Lecture Slides

Introduction: pdf, ppt

Additional reading material

- Weaving a Formal Methods Education With Problem-Based Learning
- Software engineering as a model of understanding for learning and problem solving

Useful Links

- [RODIN - Formal Methods Tool](#)

<http://www.event-b.org/>

Event-B.org

Home of Event-B and the Rodin Platform

NAVIGATION

Event-B Home
DEPLOY Home
Rodin Platform
Rodin Plug-Ins
Documentation Wiki
DEPLOY Repository
Event-B Book
Community

Event-B and the Rodin Platform

Welcome to the Event-B.org Website

Event-B is a formal method for system-level modelling and analysis. Key features of Event-B are the use of set theory as a modelling notation, the use of refinement to represent systems at different abstraction levels and the use of mathematical proof to verify consistency between refinement levels.

The Rodin Platform is an Eclipse-based IDE for Event-B that provides effective support for refinement and mathematical proof. The platform is open source, contributes to the Eclipse framework and is further extendable with plugins.

Development of Rodin is supported by the European Union ICT Project DEPLOY (2008 to 2012). Originally Rodin development was partly funded by the European Union IST Project RODIN (2004 to 2007).

Use the menu on the left to install the Rodin platform and plug-ins. The documentation wiki contains support for tool users and developers. The DEPLOY Repository contains resources including papers, Event-B examples and training material.

Event-B is an evolution of B-Method developed by Jean-Raymond Abrial. Wikipedia contains useful information and links on the B-Method.

Who are You ?

You are using the Rodin Platform. We would like to know who you are...

[More information...](#)

<http://sourceforge.net/projects/rodin-b-sharp/>

<http://sourceforge.net/projects/rodin-b-sharp/>

sourceforge FIND AND DEVELOP OPEN SOURCE SOFTWARE

Find Software Develop Create Project Blog Site Support About

SourceForge.net > Find Software > RODIN

RODIN by dissemination, halstefa, lvoisin, thanik

Summary Files Support Develop

Open tool platform for the cost effective rigorous development of dependable complex software systems services. This platform is based on the event-B formal method and provides natural support for refinement and mathematical proof.

Download Now! rodin-1.3.1-win32.zip (53.1 MB) OR View all files >

View screenshots

http://rodin-b-sharp.sourceforge.net

Show project details

http://sourceforge.net/project/showfiles.php?group_id=108850

NOTE:

The style of this download page changes regularly so you may need to search around for the files you need

File/Folder Name	Platform	Size	Date ↓	Downloads	Notes/Subscribe
Newest Files					
rodin-2.0RC1-linux.gtk.x86.zip		58.2 MB	2010-09-27	15	
rodin-2.0RC1-win32.win32.x86.zip		58.2 MB	2010-09-27	18	
rodin-2.0RC1.r9848-sources.zip		9.9 MB	2010-09-27	10	
rodin-2.0RC1-macosx.cocoa.x86_64.zip		58.0 MB	2010-09-27	7	
All Files					
Core_Rodin Platform		3.9 GB	2010-09-27	19,768	
2.0RC1		184.4 MB	2010-09-27	60	
1.3.1		166.6 MB	2010-07-06	766	

Plugin_UMIL-B	61.9 MB	2010-06-07	85,734	
Doc_UMIL-B_Tutorial	83.9 KB	2010-01-08	81	
Plugin_B2Latex	819.0 KB	2009-11-25	50,346	
Doc_Tutorial	2.0 MB	2009-11-03	6,406	
Core_	166.6 MB	2009-10-01	233	
Plugin_Feature Composition	5.0 MB	2009-07-06	15,354	
Doc_Event B LaTeX style	1.2 MB	2009-03-26	2,311	
Core_Event-B Keyboard	889.4 KB	2009-03-25	1,383	
Plugin_Mobility	929.8 KB	2007-10-31	701	
Doc_User Manual	4.5 MB	2007-10-26	5,374	
Font_Brave Sans Mono	100.5 KB	2006-03-27	2,823	

You do not yet need any of the plug-ins but you will probably need the font specific to the tool

http://sourceforge.net/project/showfiles.php?group_id=108850&package_id=181714

1.3.1		166.6 MB	2010-07-06	766	
rodin-1.3.1-sources.zip		7.5 MB	2010-07-06	29	
rodin-1.3.1-win32.zip		53.1 MB	2010-06-15	444	
rodin-1.3.1-macosx.zip		52.9 MB	2010-06-15	79	
rodin-1.3.1-linux.zip		53.1 MB	2010-06-15	166	
relnotes_1.3.1.txt		12.1 KB	2010-06-15	48	

The windows and linux versions will match your choice of OS

Rodin - Installation Overview for Windows

(Linux and Mac installations should be similar)

- Latest Java (jre +jdk) from <http://www.sun.com> – because *RODIN is built on Eclipse Platform*
- Unzip **rodin-1.3.1-win32.zip** (to **C:\Program Files**, eg)
- Place the font file in **C:\Windows\fonts**
- Start Rodin (**C:\Program Files\Rodin\Rodin.exe**) and install plugins *if instructed at the first Rodin (Eclipse) screen.*

Event-B - BirthdayBook/BirthdayBook_CO.buc - Rodin Platform

File Edit Navigate Search Project Run Refactor Event-B Window Help

Welcome

The Rodin Platform

Rodin is an open tool platform for the cost effective rigorous development of dependable complex software systems and services. This platform is based on the event-B formal method and provides natural support for refinement and mathematical proof.

This platform contributes to the Eclipse framework and is extensible using the Eclipse plug-in mechanism.

Rodin development has been partly funded by the European Commission through two RTD projects:

- project **Rodin** (FP6 IST project 511599), from September 2004 to October 2007,
- project **Deploy** (FP7 IST project 214158), since February 2008.

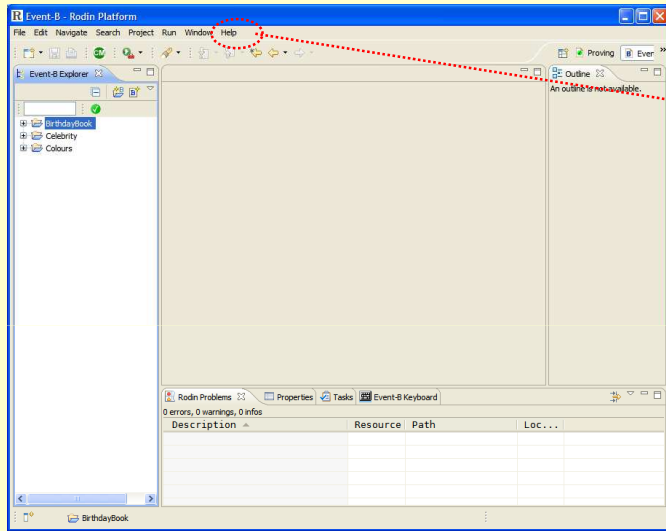
More information about this platform can be found on the Event-B.org web site, including user and developer documentation available as a [Wiki](#).

The development of this platform is hosted by SourceForge.

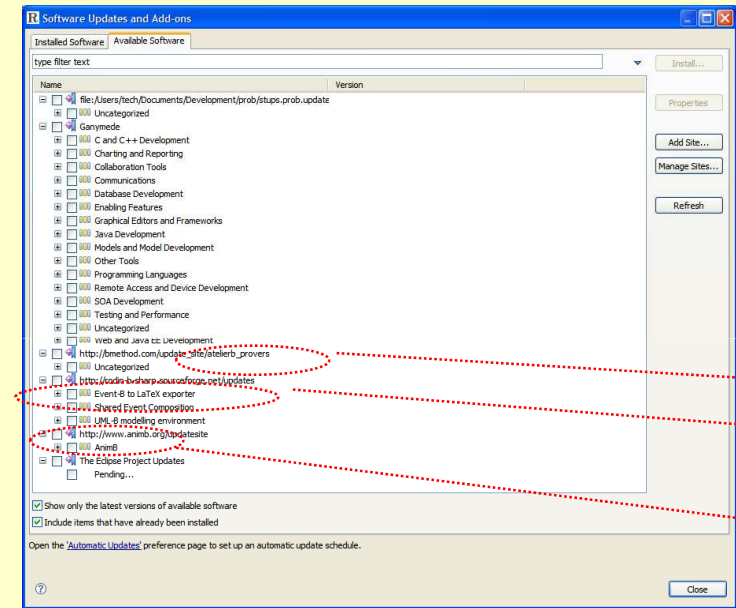
Important Installation notes

To improve your proof experience, please install the third-party provers from Atelier B. This is only a few mouse-clicks away. Please proceed as follow:

- From the main menu bar, select **Help > Software Updates...** The Software Update wizard opens.
- Click on the **Available Software** tab, then select **Atelier B provers > Uncategorized > Atelier B provers** in the tree (tick the left check boxes) and click **Install...**
- After some time, the **Install** window opens. Just click **Next**, and accept the terms in the license agreement.
- Click **Finish**. The update manager downloads the Atelier B Provers Feature.
- Finally, in the next window, click **Yes** to restart the platform.



Help
Software Updates
Available Software



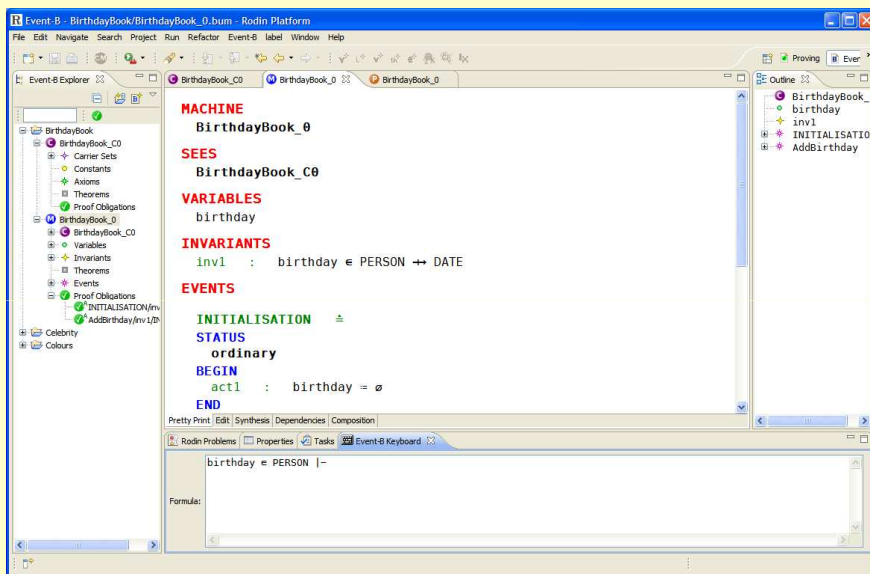
These
are
useful in
later
modules

Atelier B

B2Latex

ProB
Animator

Typical Use of Rodin – *default* Eclipse window layout



We will start to work with RODIN in the next session (on Wednesday)

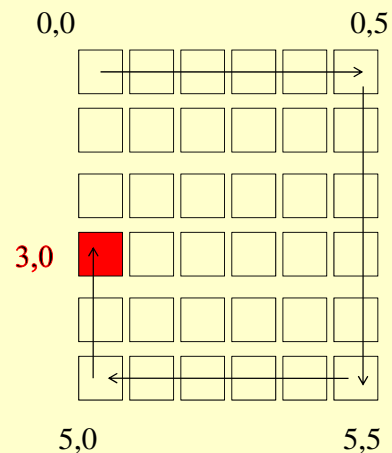
For the remainder of today I want you to work together on a mathematical problem.

This problem can be solved in a number of different ways, and using a number of techniques/skills.

My goal is to observe how you choose to work on the problem and what mathematics you choose to employ.

The problem is based on a robot walking around a rectangular grid.

Robot Walker: step1



You are to specify a function, f , that:

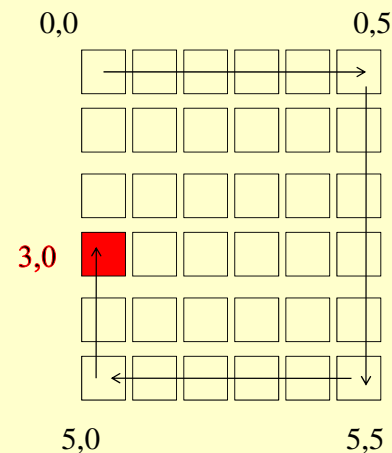
Takes as input the:

- size of a square grid

Calculates the x,y co-ordinates of the robot after it has walked *half way* around the grid following a spiral walk, starting at 0,0 and moving clockwise.

In the example the function
Calculates
 $f(6) = (3,0)$

Robot Walker: step2



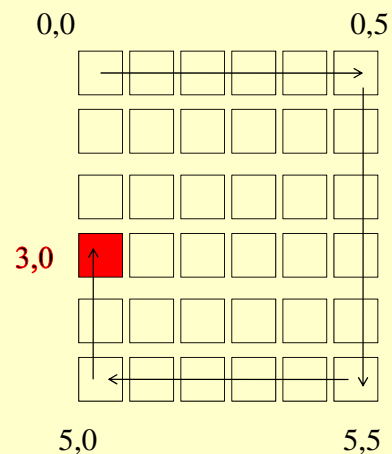
You are to specify a function, f , that:

Takes as input the
size of a square grid and
the starting corner: TopLeft,
TopRight, BottomLeft

Calculates the x,y co-ordinates of the robot after it has walked half way around the grid following a spiral walk, starting at the specified starting corner and moving clockwise.

In the example the function
Calculates
 $f(6, \text{TOPLEFT}) = (3,0)$

Robot Walker: step3



You are to specify a function, f , that:

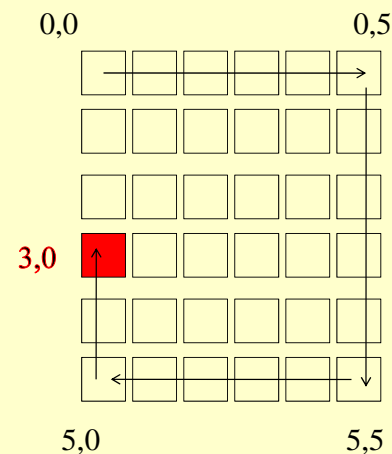
Takes as input the

- size of a square grid, and
- the starting corner: TopLeft, TopRight, BottomLeft, and
- The direction: clockwise or anticlockwise

Calculates the x,y co-ordinates of the robot after it has walked half way around the grid following a spiral walk, at the specified starting corner and moving in the specified direction

In the example the function
Calculates
 $f(6, \text{TOPLEFT}, \text{clockwise}) = (3,0)$

Robot Walker: step4



You are to specify a function, f , that:

Takes as input the
•size of a rectangular grid, and
•the starting corner: TopLeft, TopRight, BottomLeft, and
•The direction: clockwise or anticlockwise

Calculates the x,y co-ordinates of the robot after it has walked half way around the grid following a spiral walk, starting at 0,0 and moving clockwise.

In the example the function
Calculates
 $f(6,6, \text{TOPLEFT}, \text{clockwise}) = (3,0)$

Robot Walker: step5 – testing each of the previous steps

How sure are you that your function is correct?

Is it easier to do the maths if the function allows a degree of error?

What is the error bound of your function?

What mathematics did you (re)use in each step?

Would it be easier to program a solution?