

Maple and Its Role in the Development of a Mathematician

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July 14, 2004

Getting Started: Me

Introduction to Numerical Analysis (CMU, Fall 1984)

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Getting Started: Me

Introduction to Numerical Analysis (CMU, Fall 1984)

- Homework 7, Question 1 [[PDF](#)]



Getting Started: Me

Introduction to Numerical Analysis (CMU, Fall 1984)

- Homework 7, Question 1 [[PDF](#)]
- Solution [[MACSYMA](#)] [[Maple 9.5](#)]

Getting Started: Maple

1967 – MACSYMA project begins at MIT

1979 – muMATH-79 released for CP/M (8080) & TRS-DOS (Z80)

1980

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1980 – (Aug) Waterloo CS wants system to run MACSYMA

– (Dec) Geddes & Gonnet produce first MAPLE system

Year	Maple	Me
1980	MAPLE project conceived <ul style="list-style-type: none"> • Symbolic Computation Group • goal: “efficient” CAS 	Undergraduate Student <ul style="list-style-type: none"> • BGSU (Ohio)
1981		<ul style="list-style-type: none"> • Eastman Kodak Scholar
1982	Maple 1.0, 2.0, 2.1, 2.15, 2.2 <ul style="list-style-type: none"> • written in B for Unix • used locally at Waterloo 	
1983	Maple 3.0, 3.1 <ul style="list-style-type: none"> • 1st major MAPLE paper • ≈ 50 external installations 	<ul style="list-style-type: none"> • muMATH
1984	Maple 3.2 <ul style="list-style-type: none"> • distribution by WATCOM Products, Inc. • port to IBM VM/CMS and DEC VMS • convert Reference Manual to User’s Guide 	<ul style="list-style-type: none"> • B.S. (with Honors) in Math • B.S. in Computer Science Graduate Student <ul style="list-style-type: none"> • Carnegie Mellon • Intro Numerical Analysis • MACSYMA

muMATH / DERIVE

	CPU	OS	Memory
muMATH-79	8080, Z80	CP/M, TRS-DOS	48K

- written in various forms of LISP
- muSIMP (micro (μ) Symbolic IMPlementation)
- muLISP

muMATH / DERIVE

	CPU	OS	Memory
muMATH-79	8080, Z80	CP/M, TRS-DOS	48K
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muMATH-83	8088	IBM PC, XT	300K

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DERIVE (1988)		MS-DOS	512K

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DERIVE (1996)		Windows	

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1985	Maple 3.3 <ul style="list-style-type: none"> • WATCOM Products, Inc. handles license/distribution 	
1986	Maple 4.0	<ul style="list-style-type: none"> • graphics: ASCII
1987	Maple 4.1, 4.2 <ul style="list-style-type: none"> • 300 installations world-wide 	<ul style="list-style-type: none"> • check calculus/ode answers
1988	Waterloo Maple Software <ul style="list-style-type: none"> • centers at Waterloo, ETH Zürich, INRIA (France) 	<ul style="list-style-type: none"> • USENET <code>sci.math.symbolic</code> • <i>Mathematica 1.0</i>
1989	Maple 4.3 <ul style="list-style-type: none"> • 20 different OS 	<ul style="list-style-type: none"> • Ph.D. in Mathematics <p>Research Assistant Professor (Purdue)</p>
1990	Maple V <ul style="list-style-type: none"> • GUI • worksheets • 3D-graphics • Unix X-windows 	<ul style="list-style-type: none"> • Maple-generated FORTRAN for FEM

FEM Matrix Assembly

$$\begin{aligned}Mc &= f \\m_{ij} &= \langle u_i, u_j \rangle = \int \int_{\Omega} \nabla u_i \cdot \nabla u_j \\f_j &= (f, u_j) = \int \int_{\Omega} f u_j\end{aligned}$$

1990

1994

FEM Matrix Assembly

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1990 script
[Maple 4.3]

1994

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1990 script
[Maple 4.3]

1994 worksheet
[Maple V Release 3] [Maple 9.5]

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1992	Maple V Release 2	<ul style="list-style-type: none"> • recreational number theory
1993	Maple Share Library Summer Workshop (U Mich)	<ul style="list-style-type: none"> • Hankel functions
1994	Summer Workshop (RPI) MapleTech Maple V Release 3 <ul style="list-style-type: none"> • export to \LaTeX 	<ul style="list-style-type: none"> • Lilly Fellow • Maple Ambassador • Revitalizing ESM Curriculum via Symbolic Algebra (RHIT)
1995	<ul style="list-style-type: none"> • Maple Users Group (MUG) • custom GUIs via MathEdge 	<ul style="list-style-type: none"> • Revitalizing ESM Curriculum via Symbolic Algebra (RHIT) • Computer Algebra Seminar • orthogonal curvilinear coord • ICTCM
1996	Maple V Release 4 <ul style="list-style-type: none"> • Power Edition 	<ul style="list-style-type: none"> • shooting method • <i>Fund of DE</i>, Nagel/Saff

Hankel Functions

Bessel's Equation: $x^2 y''(x) + xy'(x) + (x^2 - \nu^2)y(x) = 0$

$$H_\nu^{(1)}(x) = J_\nu(x) + iY_\nu(x)$$

$$H_\nu^{(2)}(x) = J_\nu(x) - iY_\nu(x)$$

1993

•

•

Hankel Functions

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1993 script ([BesselH](#))

[Maple V Release 2] [Maple 9.5 (auto updated)]

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1993 script ([BesselH](#))

[[Maple V Release 2](#)] [[Maple 9.5 \(auto updated\)](#)]

- distributed with Maple Share Library
-

Hankel Functions

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1993 script ([BesselH](#))

[[Maple V Release 2](#)] [[Maple 9.5 \(auto updated\)](#)]

- distributed with Maple Share Library
- eventually included in Maple ([HankelH1](#), [HankelH2](#))
[[Maple 9.5 - online help](#)]

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1996	Maple V Release 4 <ul style="list-style-type: none"> • Power Edition 	<ul style="list-style-type: none"> • shooting method • <i>Fund of DE</i>, Nagel/Saff

Lilly Project



Lilly Project

- Elementary Differential Equations, Spring 1995
[WWW]



Lilly Project

- Elementary Differential Equations, Spring 1995
[WWW]
- Guest Lectures:

Lilly Project

- Elementary Differential Equations, Spring 1995
[WWW]
- Guest Lectures:
 - [Steve Dunbar (Nebraska)]
 - [Jim Herod (Georgia Tech)]
 - [Robert Lopez (Rose-Hulman)]

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Shooting Method

$$\begin{aligned}\frac{dy}{dt} &= f(t, y(t)) \\ y_i(a) &= \alpha_i \quad i = 1, 2, \dots, m_1 \\ y_{j+m_1}(b) &= \beta_j \quad j = 1, 2, \dots, m_2\end{aligned}$$

1994

1997

2000

Shooting Method

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1994 Pre-**Shoot** Package
[**Maple V r 3**]

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1994 Pre-**Shoot** Package

[[Maple V r 3](#)]

1997 **Shoot** Package (MTN [[PDF](#)])

[[Maple V r 3](#)] [[Maple V r 4](#)] [[Maple 6](#)] [[App Center](#)] [[source \(ZIP\)](#)]

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Shooting Method

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1994 Pre-**Shoot** Package

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2000 Post-**Shoot** Package

[[Maple 8 \(AEM, Lopez\)](#)] [[Maple 9.5 \(ODE PowerTool, Lesson 17\)](#)]

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Year	Maple	Me
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1998	Maple V Release 5	<ul style="list-style-type: none"> • <i>Engineer's Toolkit</i>
1999		<ul style="list-style-type: none"> • S E I R model
2000	Maple 6 Maple Application Center	<ul style="list-style-type: none"> • <i>Linear Algebra</i>, Lay • Irreducibility Tests
2001	Maple 7	Undergraduate Director <ul style="list-style-type: none"> • ODE PowerTool • <i>Thomas' Calculus</i>
2002	Maple 8 <ul style="list-style-type: none"> • maplets • MapleNet 	<ul style="list-style-type: none"> • <i>Adv Eng Math</i>, Lopez • <i>Linear Algebra</i>, JRA • <i>Calculus</i>, Johnston/Mathews
2003	Maple 9 <ul style="list-style-type: none"> • Maplesoft • MapleTA 	<ul style="list-style-type: none"> • Calculus I with Maple in Blackboard
2004	Maple 9.5	<ul style="list-style-type: none"> • Lab Materials for Calculus (including projects)

Parachute Problem

$$mx'' = -mg - k(t)x', \quad x(0) = x_0, \quad x'(0) = v_0$$

$$k(t) = \begin{cases} k_1 & t < t_d \\ k_2 & t \geq t_d \end{cases} \quad k(t) = \begin{cases} k_1 & t < t_d \\ k_d & t_d \leq t < t_d + \tau_d \\ k_2 & t \geq t_d + \tau_d \end{cases}$$

1997

1998

1999

Parachute Problem

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1997 Modelling with an Impact (MTN [[PDF](#)])

1998

1999

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1997 Modelling with an Impact (MTN [[PDF](#)])

1998 ODE Models for the Parachute Problem (SIAM Review [[PDF](#)])

1999

Parachute Problem

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1997 Modelling with an Impact (MTN [[PDF](#)])

1998 ODE Models for the Parachute Problem (SIAM Review [[PDF](#)])

1999 Differential Equations for the New Millenium
(IJEE, w/Allan Struthers [[PDF](#)] [[html](#)])

[[Maple V r 3](#)] [[Maple V r 4](#)] [[Maple V r 5.1](#)] [[Maple 9.5](#)]

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1998	Maple V Release 5	<ul style="list-style-type: none"> • <i>Engineer's Toolkit</i>
1999		<ul style="list-style-type: none"> • S E I R model
2000	Maple 6 Maple Application Center	<ul style="list-style-type: none"> • <i>Linear Algebra, Lay</i> • Irreducibility Tests
2001	Maple 7	Undergraduate Director <ul style="list-style-type: none"> • ODE PowerTool • <i>Thomas' Calculus</i>
2002	Maple 8 <ul style="list-style-type: none"> • maplets • MapleNet 	<ul style="list-style-type: none"> • <i>Adv Eng Math, Lopez</i> • <i>Linear Algebra, JRA</i> • <i>Calculus, Johnston/Mathews</i>
2003	Maple 9 <ul style="list-style-type: none"> • Maplesoft • MapleTA 	<ul style="list-style-type: none"> • Calculus I with Maple in Blackboard
2004	Maple 9.5	<ul style="list-style-type: none"> • Lab Materials for Calculus (including projects)

Maple V for Engineers

- Addison-Wesley's Engineer's Toolkit Series
co-authored with Etan Bourkoff (EECE)



Maple V for Engineers

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- Chapter 6: Advanced Engineering Applications
[\[PDF\]](#)
- Chapter 7: Intro to Maple Programming
[\[PDF\]](#)
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[\[PDF\]](#)
- Instructor's Guide
[\[Maple V Release 4\]](#)

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laylinalg Package*

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**Introduction to Linear Algebra*, David C. Lay, 3rd ed., 2003.
[[Instructor Resources](#)] [[Supplements](#)] [[Technology](#)]

laylinalg Package*

- Student Study Guide [[PDF](#)]
- Instructor Maple Manual [[PDF](#)]
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[[Spotted Owl](#)]

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Irreducibility Tests for 0-1 Polynomials

2000

2001

2004

Irreducibility Tests for 0-1 Polynomials

2000 `cgi`-based Web forms
[Irreduc] [Cyclotomic]

2001

2004

Irreducibility Tests for 0-1 Polynomials

2000 [cgi-based Web forms](#)
[\[Irreduc\]](#) [\[Cyclotomic\]](#)

2001 pre-print [\[PDF\]](#)

2004

Irreducibility Tests for 0-1 Polynomials

2000 [cgi](#)-based Web forms
[\[Irreduc\]](#) [\[Cyclotomic\]](#)

2001 pre-print [\[PDF\]](#)

2004 maplet
[\[Irreduc.maplet\]](#) [\[via MapleNet\]](#)

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ODE PowerTool



ODE PowerTool

- Maple Application Center [[WWW](#)]



ODE PowerTool

- Maple Application Center [[WWW](#)]
- PowerTool [[WWW](#)]
-
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ODE PowerTool

- Maple Application Center [[WWW](#)]
- PowerTool [[WWW](#)]
- ODE Powertool [[WWW](#)]
-

ODE PowerTool

- Maple Application Center [[WWW](#)]
- PowerTool [[WWW](#)]
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- Lesson 6: Bifurcations
[[Maple 8](#)] [[Maple 9.5](#)]

Year	Maple	Me
1997		Associate Professor (USC) <ul style="list-style-type: none"> • parachute problem
1998	Maple V Release 5	<ul style="list-style-type: none"> • <i>Engineer's Toolkit</i>
1999		<ul style="list-style-type: none"> • S E I R model
2000	Maple 6 Maple Application Center	<ul style="list-style-type: none"> • <i>Linear Algebra, Lay</i> • Irreducibility Tests
2001	Maple 7	Undergraduate Director <ul style="list-style-type: none"> • ODE PowerTool • <i>Thomas' Calculus</i>
2002	Maple 8 <ul style="list-style-type: none"> • maplets • MapleNet 	<ul style="list-style-type: none"> • <i>Adv Eng Math, Lopez</i> • <i>Linear Algebra, JRA</i> • <i>Calculus, Johnston/Mathews</i>
2003	Maple 9 <ul style="list-style-type: none"> • Maplesoft • MapleTA 	<ul style="list-style-type: none"> • Calculus I with Maple in Blackboard
2004	Maple 9.5	<ul style="list-style-type: none"> • Lab Materials for Calculus (including projects)

Calculus I with Maple in Blackboard

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Calculus I with Maple in Blackboard

- Blackboard-based self-contained course
[Home] [Unit] [Lessons] [Homework / Quizzes / Exams]



Calculus I with Maple in Blackboard

- Blackboard-based self-contained course
[Home] [Unit] [Lessons] [Homework / Quizzes / Exams]
- MapleNet / maplet
[EpsilonDelta] [Calculus1 maplets]
-

Calculus I with Maple in Blackboard

- Blackboard-based self-contained course
[Home] [Unit] [Lessons] [Homework / Quizzes / Exams]
- MapleNet / maplet
[EpsilonDelta] [Calculus1 maplets]
- MapleTA
Practice: [Q1] [Q2] [Q3] [Q4] [Q5]

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Lab Materials / Projects for Calculus

2002-3

2003-4



2004-5

Lab Materials / Projects for Calculus

2002-3 pilot lecture

2003-4



2004-5

Lab Materials / Projects for Calculus

2002-3 pilot lecture

2003-4 test lectures



2004-5

Lab Materials / Projects for Calculus

2002-3 pilot lecture

2003-4 test lectures

- Fall 2003
[Course] [Labs] [Week 1] [Lab 1]

-

2004-5

Lab Materials / Projects for Calculus

2002-3 pilot lecture

2003-4 test lectures

- Fall 2003
[Course] [Labs] [Week 1] [Lab 1]
- Spring 2004
[Course] [Labs] [Week 1] [Week 2] [Lab 1]

2004-5

Lab Materials / Projects for Calculus

2002-3 pilot lecture

2003-4 test lectures

- Fall 2003
[Course] [Labs] [Week 1] [Lab 1]
- Spring 2004
[Course] [Labs] [Week 1] [Week 2] [Lab 1]

2004-5 full implementation

Year	Maple	Me
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The Next 25 Years

- Education
 - improved mathematics
 - specialized toolboxes
- Research
 - improved interface
 - additional graphics
- Commercial
 - inter-application communication
 - improved efficiency