Spring 2015 Welcome

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Paul du Bois-Reymond (1889) PDE Classification

Talking Points

Grade Distributions
Email
Accommodations

Classifications of 2-D PDE's

Write $Au_{xx} + 2Bu_{xy} + Cu_{yy} + Du_x + Eu_y + Fu = 0$ as the quadratic $Ax^2 + 2Bxy + Cy^2 + Dx + Ey + F = 0$ and classify by the eigenvalues of quadratic form

$$\begin{bmatrix} A & B \\ B & C \end{bmatrix}$$

opposite signs means hyperbolic, same signs means elliptic, one zero parabolic

Pierre-Simon Laplace (c1780) Laplace's Equation

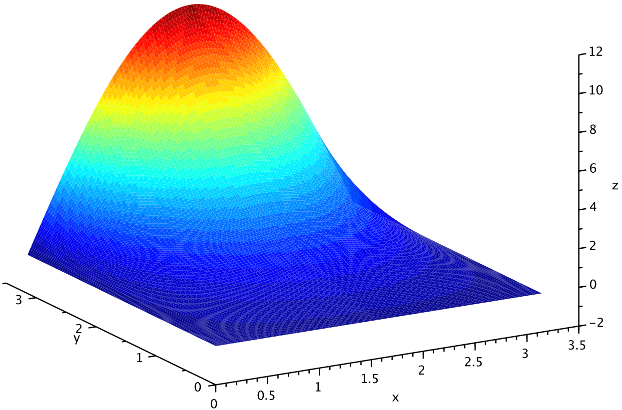
Properties of Solutions

$$u_{xx} + u_{yy} = 0$$

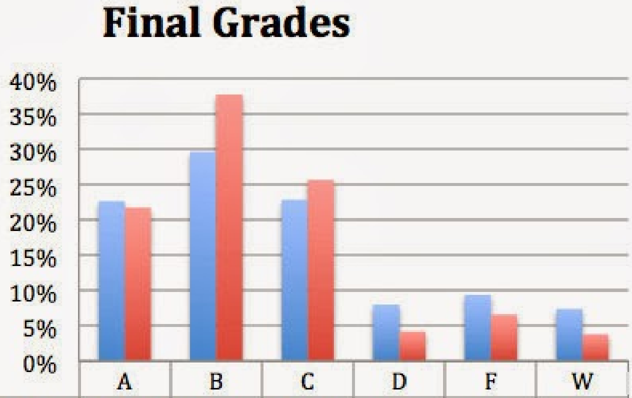
Speed Zero
Solutions Harmonic – Power Series
Elliptic
Steady State Temperature

Typical Solution

Laplace Solution $z = \sin(x)\sinh(y)$



http://www.maa.org/CSPCC



	A	B	C	D	F	W
all PhD universities	22.7%	29.7%	22.9%	8.0%	9.4%	7.4%
5 case study sites	21.8%	37.8%	25.7%	4.2%	6.6%	3.8%

Figure 1: Instructor reported final grades.

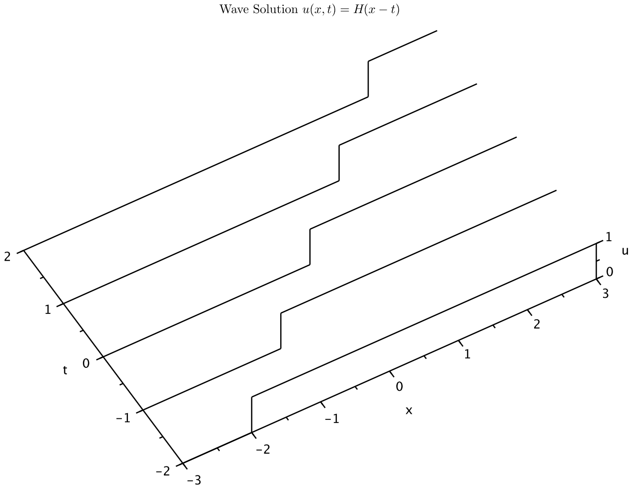
Jean le Rend d'Alembert (1748) Wave Equation

Properties of Solutions

$$u_{xx} = u_{tt}$$

Finite Speed
Discontinuous Solutions
Hyperbolic
Vibrating String

Typical Solution



Wave Equation and Email

Advisors (other than Pamela) are not your friend

- Do not reply to email from students wanting to add your class – just forward them to advisor@math.fsu.edu

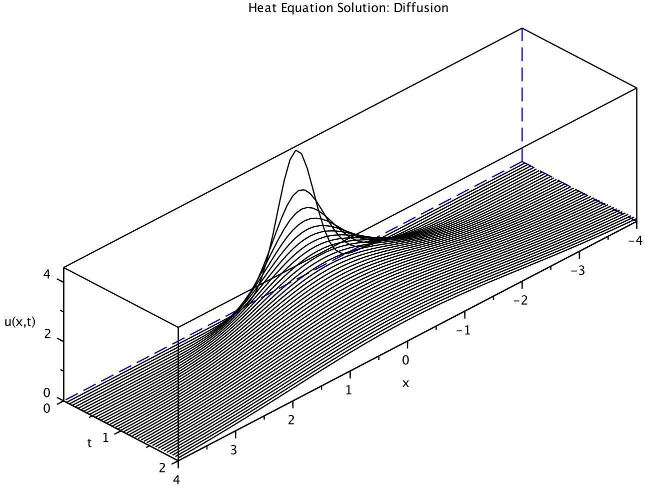
Jean-Baptiste Fourier (1810-1822) Heat Equation

Properties of Solutions

$$u_{xx} = u_t$$

Speed Infinity
Solutions C^∞
Parabolic
Diffusion

Typical Solution



Heat Equation and Accommodations

- The letter isn't the request – It is a basis for discussion.
- Unlimited Excused Absences – One extra excused absence.

$u = H(x-t)$ is a solution to $u_{xx} - u_{tt} = 0$

H is the Heaviside function

$$H(x) = \begin{cases} 1 & x > 0 \\ 1/2 & x = 0 \\ 0 & x < 0 \end{cases}$$

Show $u_x + u_t = 0$

Step 1: Integate with respect to x first

$$\begin{aligned}
\langle u_x, \phi\rangle &= -\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} u(x,t)\phi_x(x,t)\,dx\,dt \\
&= -\int_{-\infty}^{\infty}\int_{t}^{\infty} \phi_x(x,t)\,dx\,dt \\
&= -\int_{-\infty}^{\infty} -\phi(t,t)\,dt \\
&= \int_{-\infty}^{\infty} \phi(t,t)\,dt
\end{aligned}$$

Step 2: Integate with respect to t first

$$\begin{aligned}\langle u_t, \phi\rangle &= -\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} u(x,t)\phi_t(x,t)\,dt\,dx \\ &= -\int_{-\infty}^{\infty}\int_{-\infty}^{x} \phi_t(x,t)\,dt\,dx \\ &= -\int_{-\infty}^{\infty} \phi(x,x)\,dx \\ &= -\int_{-\infty}^{\infty} \phi(t,t)\,dt\end{aligned}$$

Step 3

We now know $u_x + u_t = 0$ so

$$0 = \left(\frac{\partial}{\partial x} - \frac{\partial}{\partial t}\right)(u_x + u_t) = u_{xx} + u_{xt} - u_{tx} - u_{tt} = u_{xx} - u_{tt}$$

Finally

You have a lot of support, if you need help, ask.
You are the math department.