

Love Quantification

Quality quantification for sceptics

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The Word from the Lord!

Gilb's PRINCIPLE OF 'QUALITY QUANTIFICATION'

“All qualities can be expressed quantitatively”,
'qualitative' does *not* mean unquantifiable.

And.. Quantification is NOT the same as MEASUREMENT!

"In physical science the first essential step in the direction of learning any subject is to find principles of numerical reckoning and practicable methods for measuring some quality connected with it.

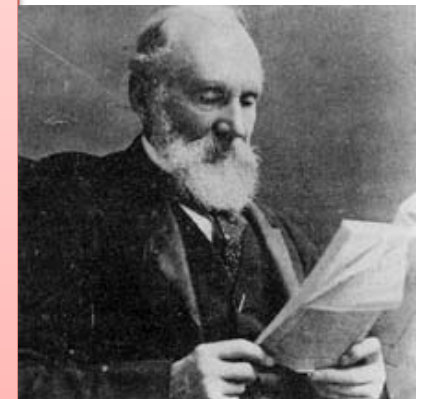
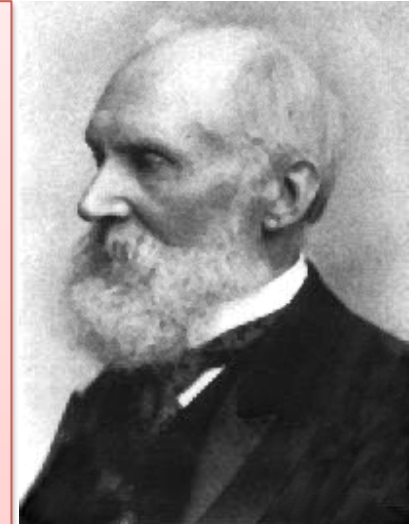
I often say that when you can **measure** what you are speaking about, **and express it in numbers**, you know something about it;

but when you cannot **measure** it, when you cannot **express it in numbers**, your knowledge is of a **meagre and unsatisfactory kind**;

it may be the beginning of knowledge, but you have scarcely in your thoughts advanced to the state of Science, whatever the matter may be.”

Lord Kelvin, 1893

From <http://zapatopi.net/kelvin/quotes.html>



“All Qualities can be expressed Quantitatively”

Means

- It seems to be always possible to do so, ***technically***
 - i.e. to ***define*** a ‘scale of measure’
 - And
- Seems possible to always put useful numbers in terms of that scale, for a real world
 - In order to express present, past, and future states of that quality
 - In order to ‘analyze’ and to specify ‘requirements’ levels

Does NOT imply

- You always should quantify
 - It should ‘pay off’ to do so
- Nor imply, “Context free numbers”
 - We define context completely and unambiguously, in Planguage
 - Where, when, if
 - Assumptions
 - Issues
 - Terms: defined as:.....
- And is NOT related to the measuring tool you may or may not apply!
 - You can usefully quantify without ever intending or really measuring!
 - Quantification is ‘language’, Measurement is ‘Process’

But many people (you?) are quite sceptical of this idea of **'quality quantification'**

Belief

- Cannot be done
- Nobody ever did it
- Too difficult to do
- Too difficult to 'measure'
 - accurately
 - reliably

But

- Just because you cannot quantify a quality concept, does not mean it cannot be done!
- I did not say "*qualitative* concept" I said a **'quality'**
 - Which I define as "a dimension of **how well** a function is performed"
 - Aka 'ilities'
 - NOT How MUCH, (work capacity)
 - NOT 'HOW' (design)
- Try: Google-ing it
 - "Intuitiveness Metric (Gilb)"

Eindhoven Holland
Real Case Exercise: *Aspects of Love, or
Love is a many splendored thing!*

The 'Challenge': “**You can’t quantify ‘Love, Tom!’**”

- **Teachable Method:**

- Make an inventory of love’s many aspects
 - Duration: 6 minutes
 - Same method as Descartes, ‘Analysis’
- Quantify one requirements for love
 - Descartes Method: mastering each decomposed detail
- The concept (Love) is the SET of aspects
 - Cartesian ‘Synthesis’



See note for Sutra

Descartes On Small

- “We should bring the whole force of our minds to bear
 - upon the most minute and simple details
 - and to dwell upon them for a long time
 - so that we become accustomed to perceive the truth
 - clearly and distinctly.”
- Rene Descartes, 'Rules for the Direction of the Mind', 1628

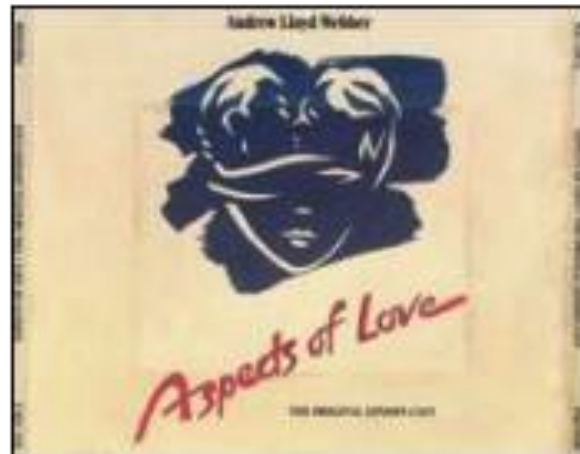


Love Attributes:

Brainstormed By Dutch Male Engineers

(French *Women* might have a different 'model')

- *Kissed-mess*
- *Care*
- *Sharing*
- *Respect*
- *Comfort*
- *Friendship*
- *Sex*
- *Understanding*
- *Support*
- *Attention*
- *Passion*
- *Satisfaction*



Notice that the 'Arts' have long understood that 'Love' has multidimensional attributes!

- Kissed-ness
- Care
- Sharing
- Respect
- Comfort
- Friendship
- Sex
- Understanding
- Trust

Support
Attention
Passion
Satisfaction
...
...



Which aspect do you guess they chose to quantify first?

Part of their list

- Kissed-ness
- Care
- Sharing
- Respect
- Comfort
- Friendship
- Sex
- Understanding
- Trust

Which aspect do you guess they chose to quantify first?

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NO! Not THAT one!

Which aspect do you guess they chose to quantify first?

Part of their list

- Kissed-ness
- Care
- Sharing
- Respect
- Comfort
- Friendship
- Sex
- Understanding
- Trust

NO! Not THAT one!

- This one



Trust [Caroline]

- **Love.Trust.Truthfulness** ←

Ambition: No lies.

Scale:

Average **Black** lies/month from
[defined sources].

Meter:

independent confidential log from
sample of the defined sources.

Past Lie Level:

Past [My Old Mate, 2004] 42 <-
Bart

Goal

[My Current Mate, Year = 2005]
Past Lie Level/2

Black: Defined: Non White Lies

- Other aspects of Trust:

- 1. 'Truthfulness'

2. Broken Agreements

3. Late Appointments

4. Late delivery

5. Gossiping to Others

The British are too shy to confront ideas like 'love' and 'sex' directly

- They use euphanisms
 - Like 'Camaraderie'

Camaraderie (Real Case UK)

Ambition: *to maintain an exceptionally high sense of good personal feelings and co-operation amongst all staff: family atmosphere, corporate patriotism. In spite of business change and pressures.*

Scale: probability that individuals enjoy the working atmosphere so much that they would not move to another company for less than 50% pay rise.

Meter: Apparently real offer via CD-S

Past [September 2001] 60+ % <- R & CD

Goal [Mid 2002] 10%, [End 2002] <1% <- R & CD

Rationale:

maintain staff number, and morale as core of business and business predictability for customers.

My 'Christian' Friend

- Lawrence Day. Seattle Washington
 - Divinity Doctor (hobby)
 - Lay Preacher
 - President <Christian Fellowship Association> (USA)
 - Web business processes, Boeing
- “Love (a central Christian value) is not quantifiable”
 - Not in Bible
 - Little guidance from God and Jesus
 - About Love Engineering



Silence for 6 weeks

- But then an email appeared from Lawrence
- “Humble apologies Tom
 - But, you were right.....

Love: Biblical Dimensions

<- Lawrence Day, Boeing

A person who loves acts the following way toward the person being loved:

**The biblical citation
(Book of First
Corinthians) I included
gives the quantification
of the term
"love" (agape in
Greek). The
'quantification' for love
would be as follows:**

----->



1. suffereth long
2. is kind
3. envieth not
4. vaunteth not itself, vaunteth...:
or, is not rash (Vaunt = extravagant self
praise)
5. is not puffed up
6. Doth not behave itself unseemly
7. seeketh not her own
8. is not easily provoked
9. thinketh no evil
10. Rejoiceth not in iniquity (=an unjust act)
11. rejoiceth in the truth
12. Beareth all things
13. believeth all things
14. hopeth all things
15. endureth all things
16. never faileth

A Paper on 'Love Quantified'

http://www.gilb.com/tiki-download_file.php?fileId=335

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Love Quantified

By:

Lawrence E. Day

for

Dr. Larry Beebe

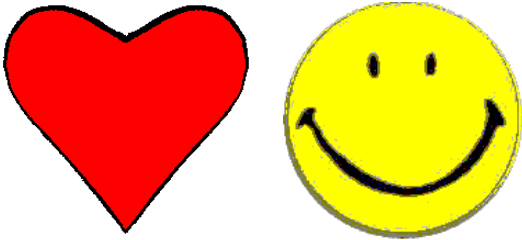
And

Dr. Raghu Korrapati

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Mathematical Models of Love & Happiness



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Presented to the
**Chaos and Complex
Systems Seminar**

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Outline

- **Love model** - Inspired by Steve Strogatz (Cornell University)
- **Happiness model** - In collaboration with Keith Warren (Ohio State Univ)

Simple Linear Model

- $dR/dt = aR + bJ$
- $dJ/dt = cR + dJ$
- where
 - R is Romeo's love for Juliet
 - J is Juliet's love for Romeo
 - (or hate if negative)
 - a, b, c, d are constants that determine the “Romantic styles”

Limitations of Model

- It's difficult to quantify and measure love and hate.
- Love is not a scalar (different types).
- Parameters change in time and with the situation.
- Parameters may be different for love and hate.
- There are always other variables

Some “Romantic Styles”

$$dR/dt = aR + bJ$$

- $a=0$ (out of touch with own feelings)
- $b=0$ (oblivious to other's feelings)
- $a>0, b>0$ (eager beaver)
- $a>0, b<0$ (narcissistic nerd)
- $a<0, b>0$ (cautious lover)
- $a<0, b<0$ (hermit)

Number of Pairings

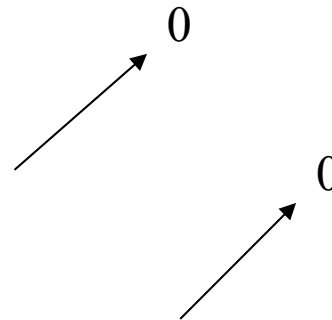
- 6 styles for Romeo X 6 styles for Juliet = 36 different pairings.
- Only 21 give unique dynamics (because of R/J symmetry)

but... It's actually worse than that:

- 4 parameters with 3 choices (-,0,+) for each gives $3^4 = 81$ combinations of which 45 are unique
- And there are subclasses depending on values and initial conditions.

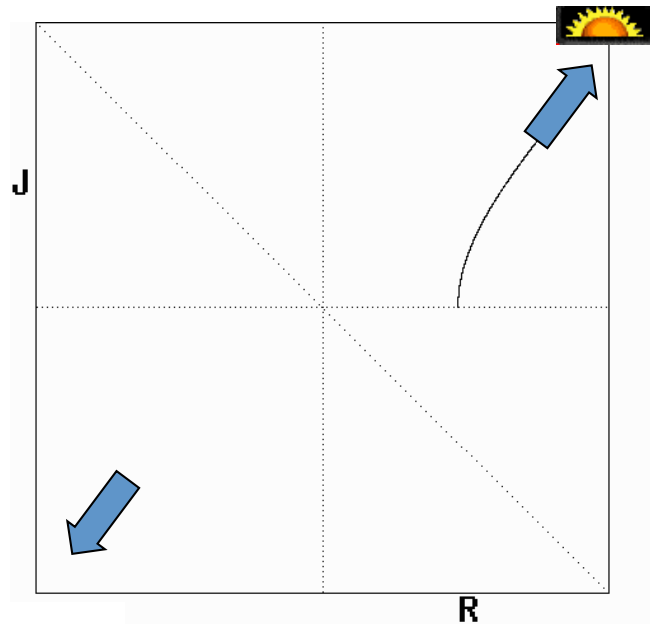
Both out of touch with their own feelings

- $dR/dt = aR + bJ$
- $dJ/dt = cR + dJ$
- Four subclasses:
 - $b > 0, c > 0$ (mutual love fest or war)
 - $b > 0, c < 0$ (never-ending cycle)
 - $b < 0, c > 0$ (never-ending cycle)
 - $b < 0, c < 0$ (unrequited love)



Out of touch with their own feelings (continued)

$$b > 0, c > 0$$

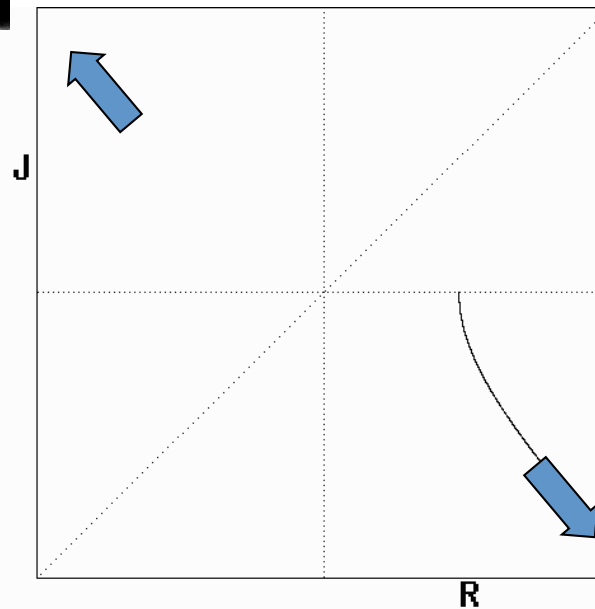


War

Two lovers

Love fest (or war)

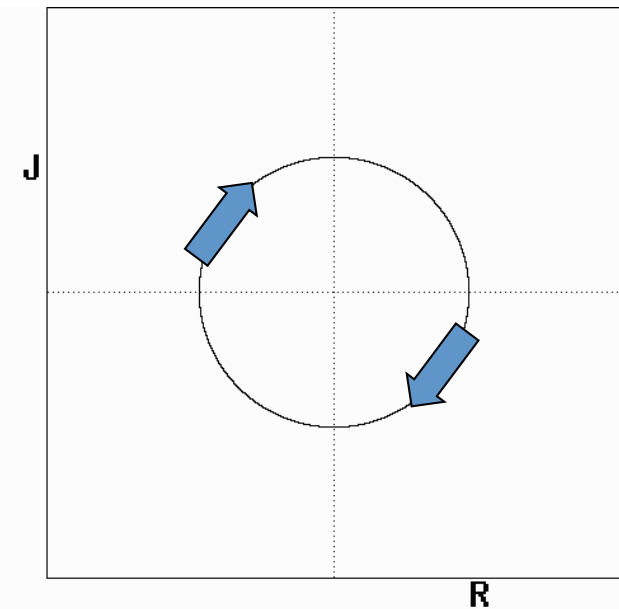
$$b < 0, c < 0$$



Two nerds

Unrequited love

$$b > 0, c < 0$$

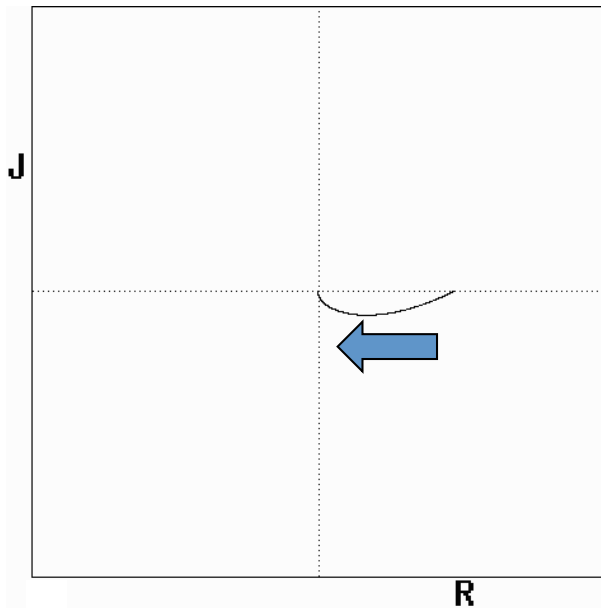


Nerd + lover

Never-ending cycle

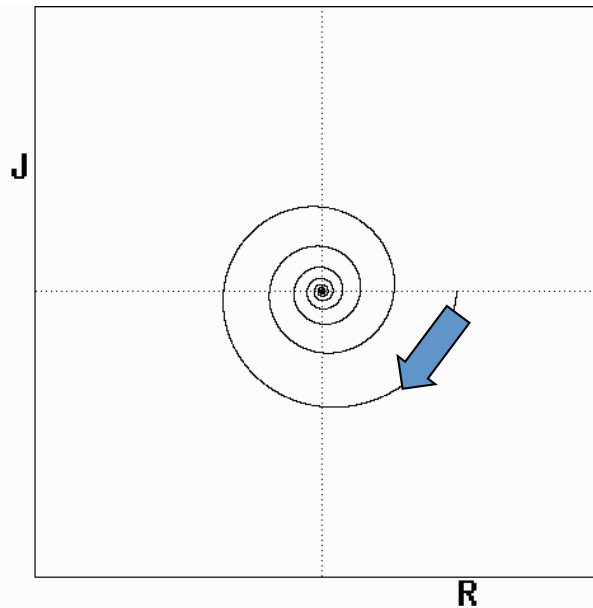
With Self-Awareness and $bc < 0$ (nerd + lover)

$$a + d < -2|bc|^{1/2}$$



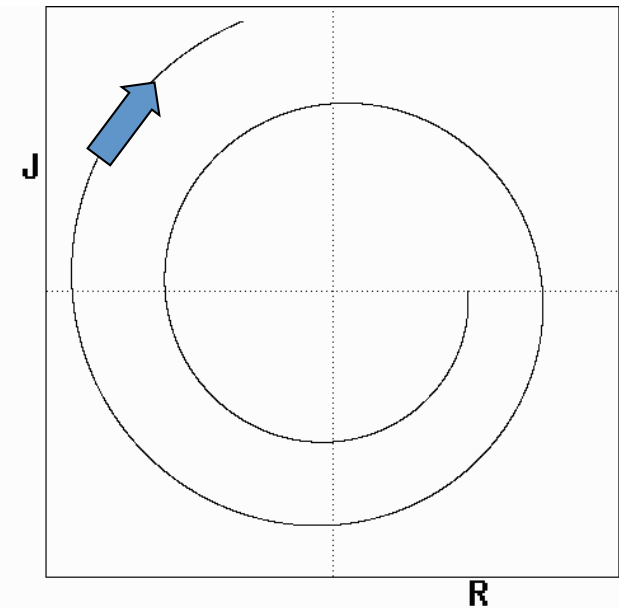
Extremely cautious
Rapid apathy

$$a + d < 0$$



Somewhat cautious
Eventual apathy

$$a + d > 0$$



Overly eager
Growing volatility

Fire and Water

(Do opposites attract?)

- Take $c = -b$ and $d = -a$
- Result depends on a , c , and the initial conditions
- Can end up in any quadrant
- Or with a steady oscillation
- But never apathy

Peas in a Pod

(Are clones bored or blissful?)

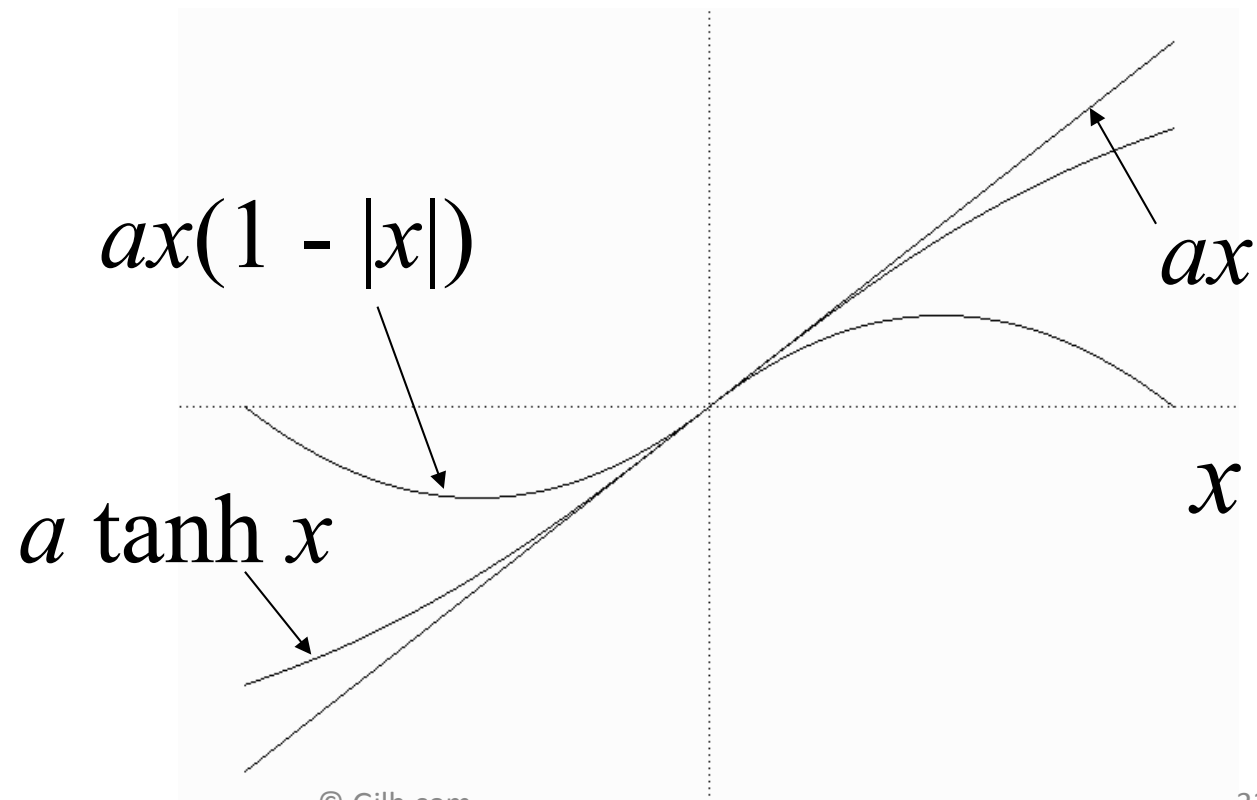
- Take $c = b$ and $d = a$
- Result depends on a , b , and the initial conditions
- Can end up in any quadrant
- Or at the origin (boredom)

Romeo the Robot (How does Juliet react?)

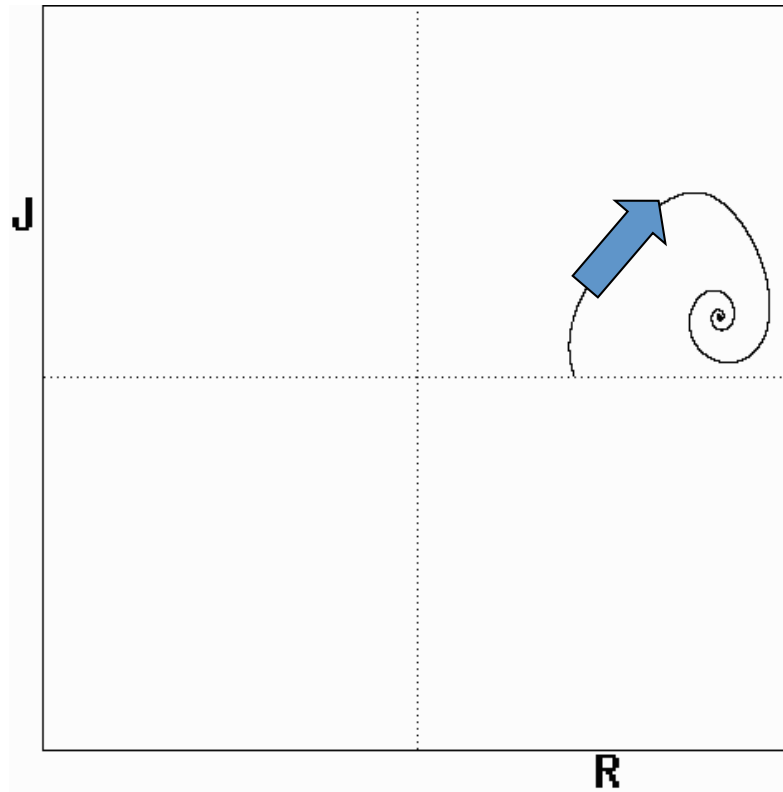
- Take $a = b = 0$ ($dR/dt = 0$)
- $dJ/dt = cR + dJ$
- There is an equilibrium at $J = -cR/d$
- Can be either love or hate depending on signs of R , c , and d
- Stable if $d < 0$, unstable if $d > 0$
- Her feelings never die
- No oscillations are possible

Effect of Nonlinearities

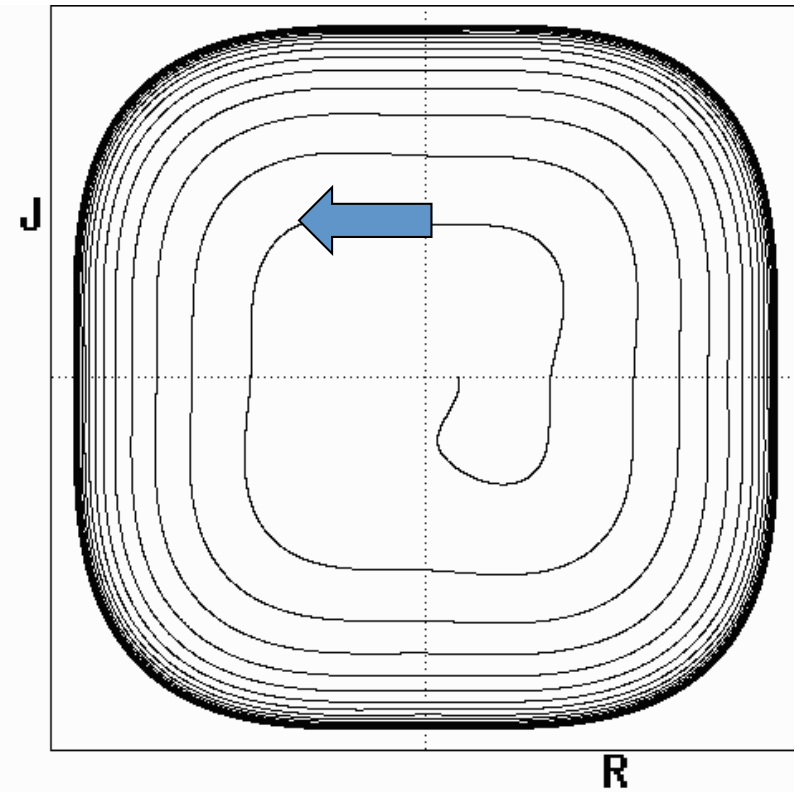
Replace ax with $ax(1-|x|)$, etc.
(logistic function)



New kinds of Dynamics



New equilibrium points



Limit cycles

(but no chaos in 2D)

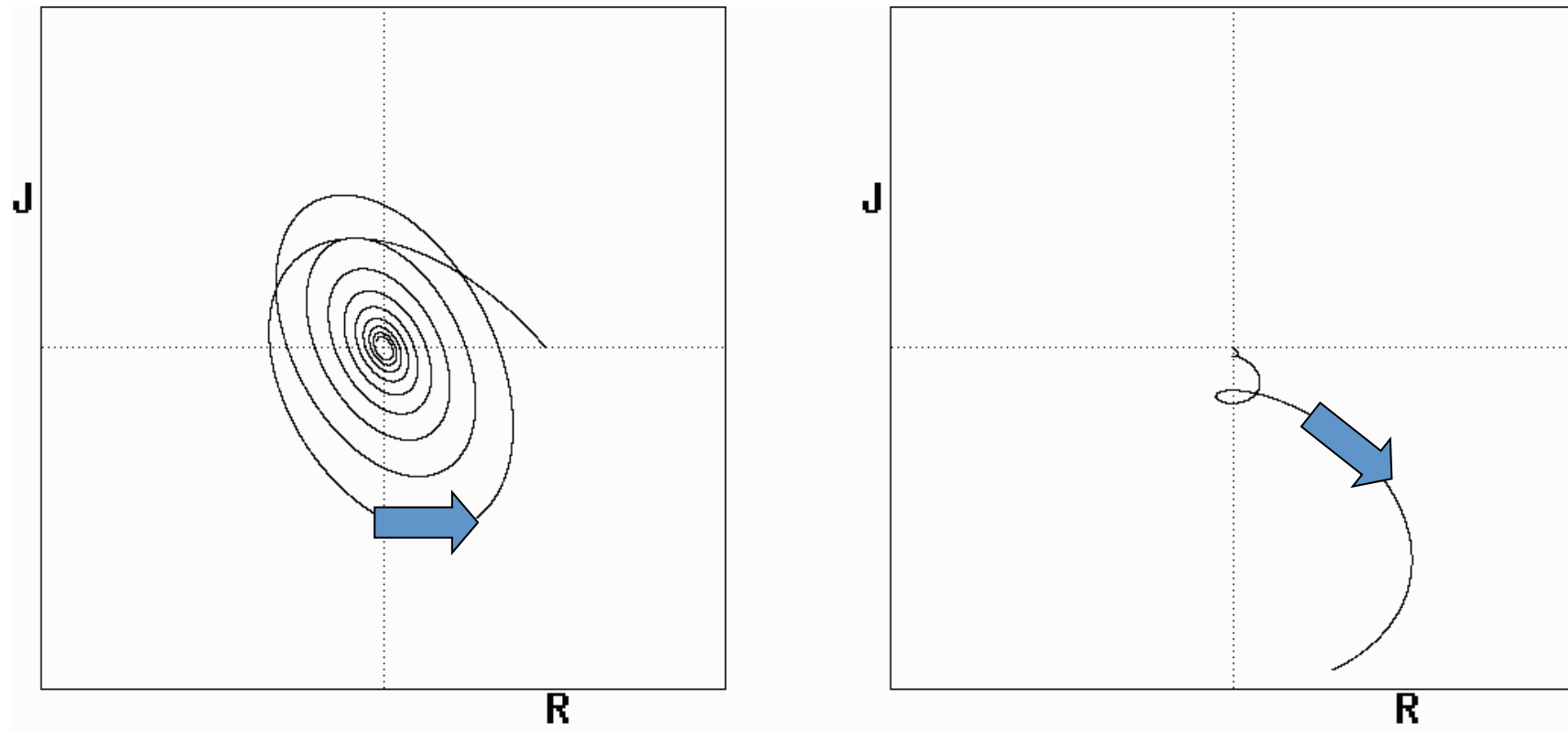
A Love Triangle

- Romeo has a mistress, Guinevere
- Guinevere and Juliet don't know about one another
- Romeo responds to each with the same romantic style (same a and b)
- Guinevere's hate has the same effect on his feelings for Juliet as does Juliet's love, and vice versa

Love Triangle Equations

- $dR_J/dt = aR_J + b(J - G)$
- $dJ/dt = cR_J + dJ$
- $dR_G/dt = aR_G + b(G - J)$
- $dG/dt = eR_G + fG$
- System is 4D (4 variables)
- There are 6 parameters
- System is linear (no chaos)

Linear Love Triangle Examples

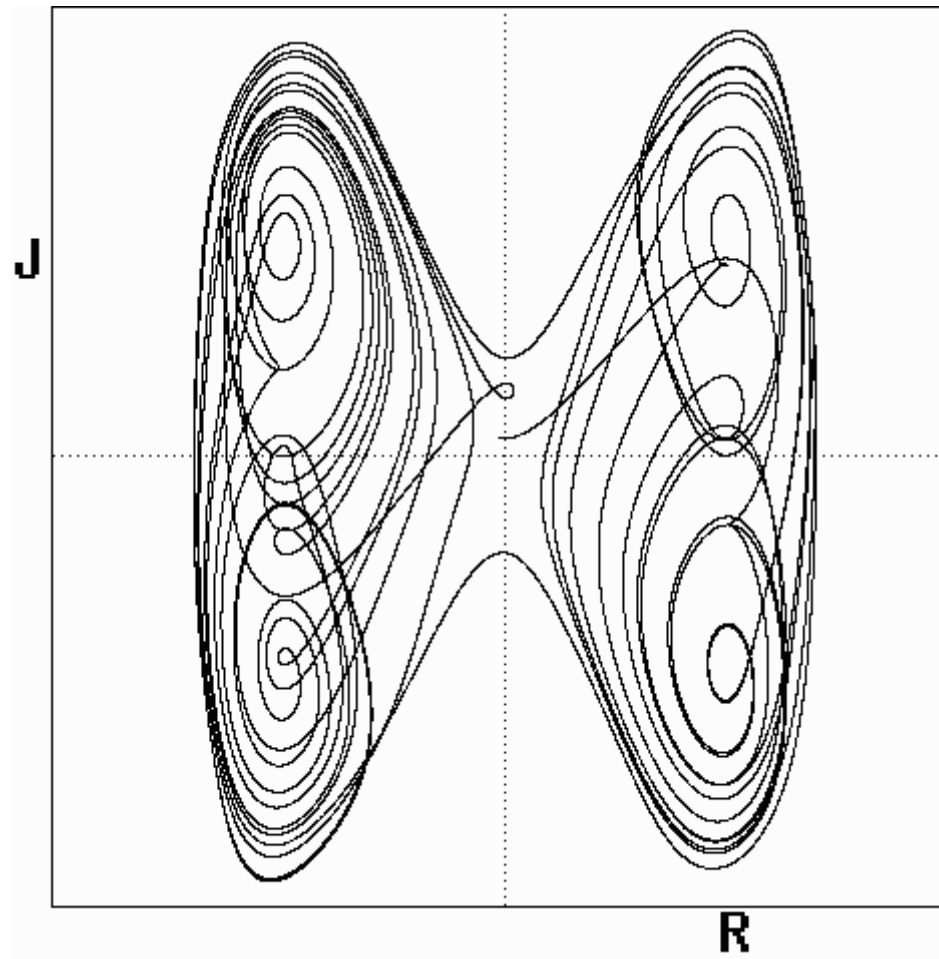


Romeo's Fate

- Averaged over all romantic styles (combinations of parameters) and initial conditions:
 - 37% loves Juliet & hates Guinevere
 - 37% loves Guinevere & hates Juliet
 - 6% loves both (2% everyone in love)
 - 6% hates both (2% everyone in hate)
 - 14% apathy (10% everyone apathetic)
- Anything can happen!

One Chaotic Solution of Nonlinear Love Triangle

“Strange attractor of love”



$a, b, c, f > 0; d, e < 0$
(Romeo is an “eager beaver”)

April 16, 10

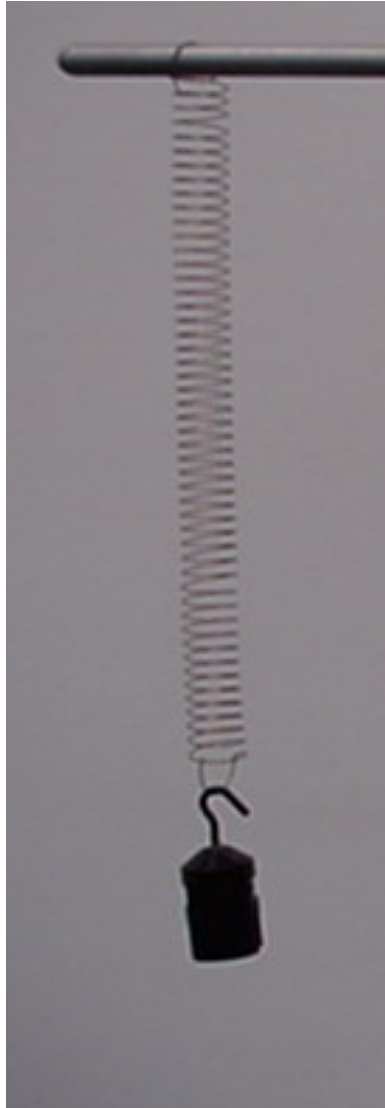
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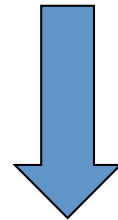
Possible Further Studies

- What happens if Guinevere and Juliet know about one another? (6D system)
- What happens if only Guinevere knows about Juliet? (5D system, asymmetric)
- What happens if Juliet and/or Guinevere has another lover? (6D or 8D system)
- What are the dynamics of a free-love commune? (large-D system)
- Is there an optimum pairing of romantic styles that encourages success or portends failure?

Simple 2D Linear Model

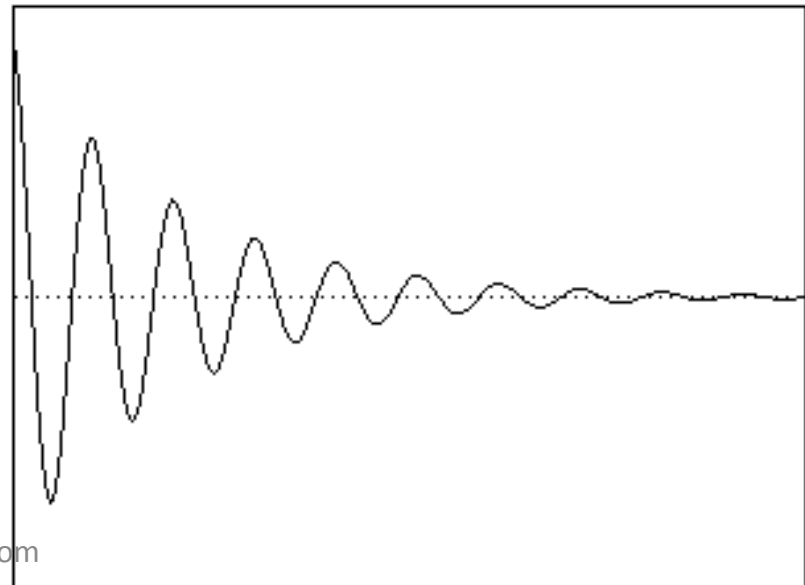
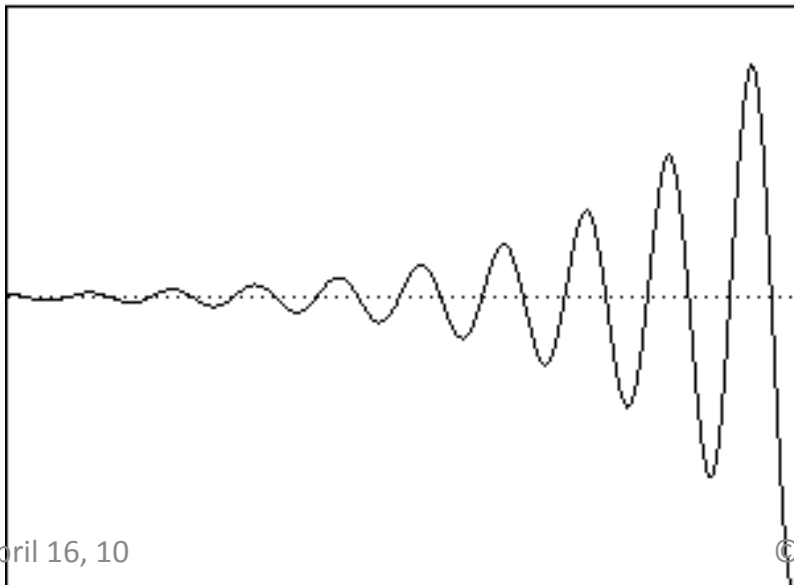
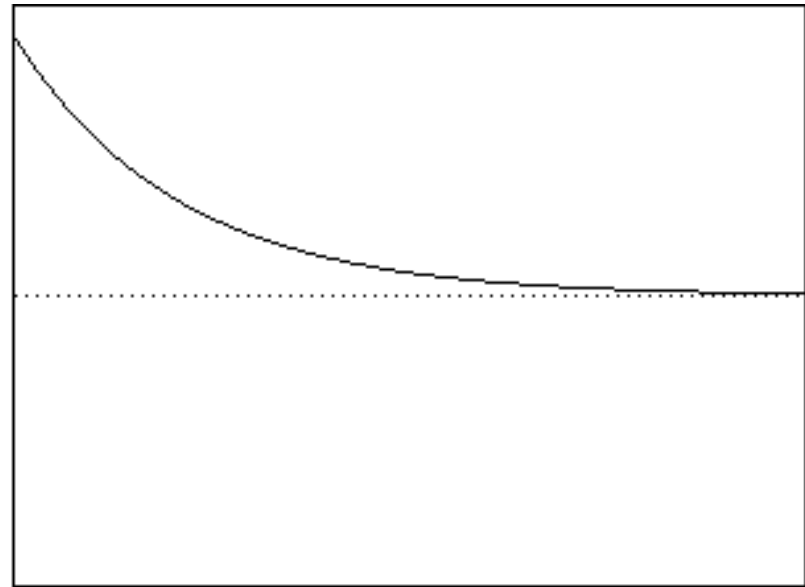
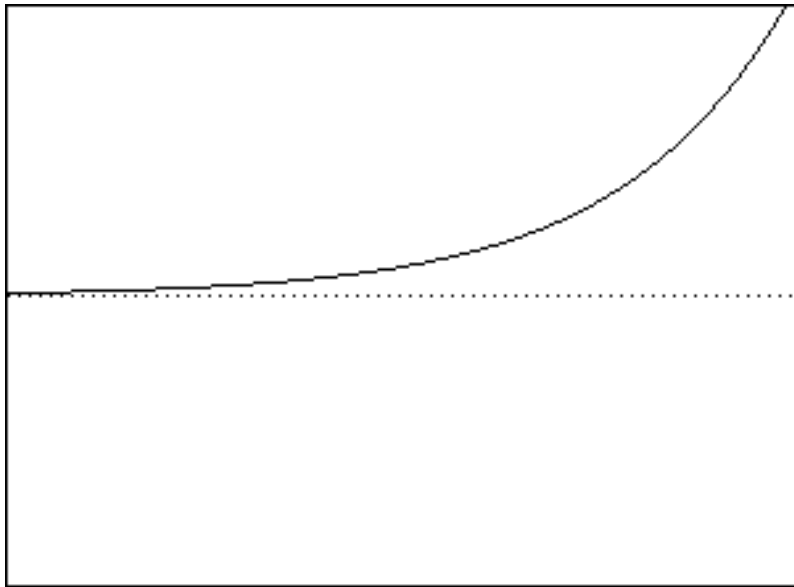


- $dR/dt = aR + bJ$
- $dJ/dt = cR + dJ$



- $d^2R/dt^2 + \beta dR/dt + \omega^2 R = 0$
 - $\beta = -a - d$ (damping)
 - $\omega^2 = ad - bc$ (frequency)

Solutions of 2-D Linear System



Happiness Model

- $d^2x/dt^2 + \beta dx/dt + \omega^2 x = F(t)$

Damping

Oscillation

External forces

- Happiness: $H = dx/dt$
 - Habituation
 - Acclimation
 - Adaptation
- Only changes are perceived

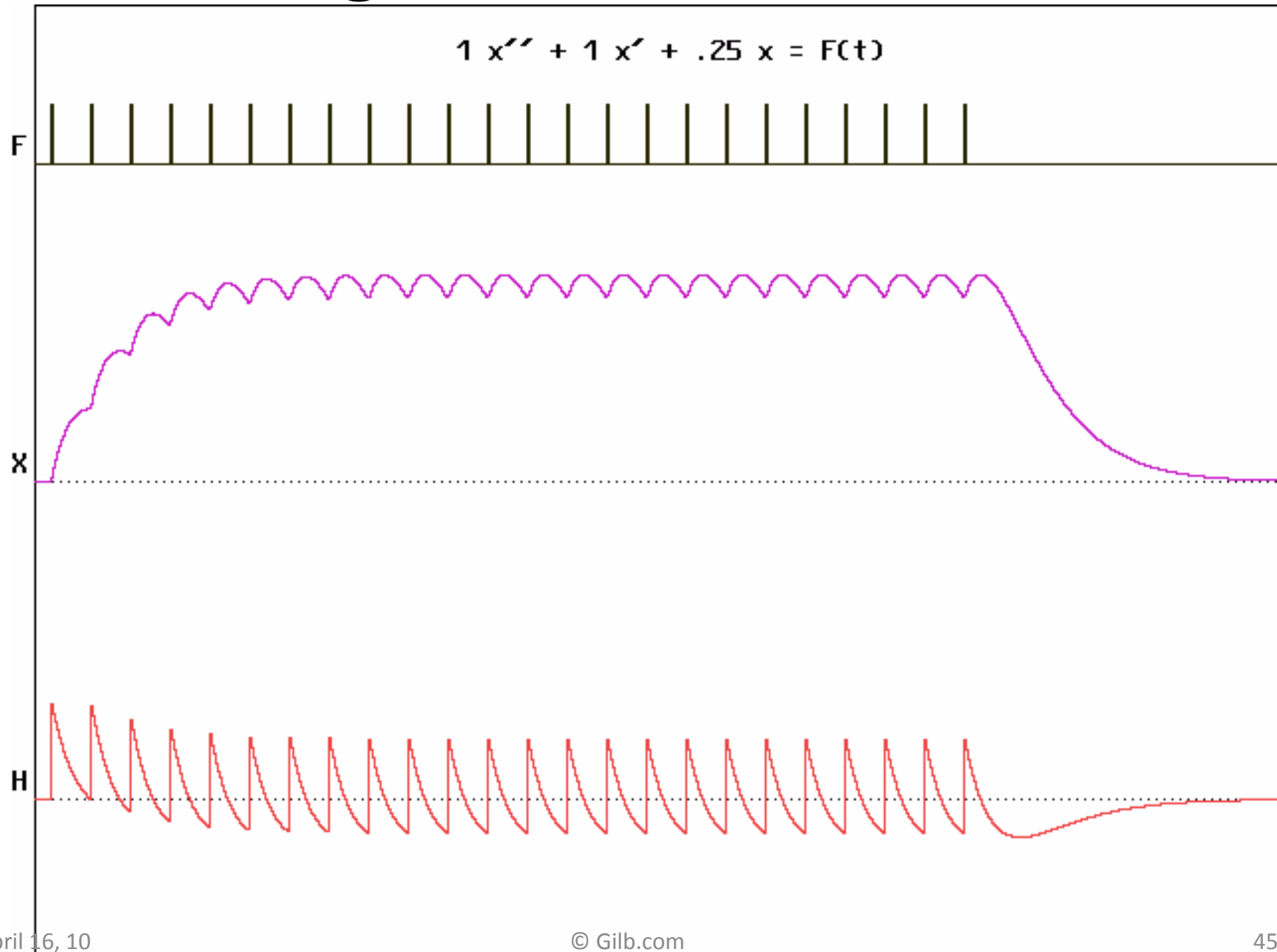
What is x ?

- x = integral of H
- x is what others perceive
- H (your happiness) must average to zero (with positive damping)
- x does not average to zero

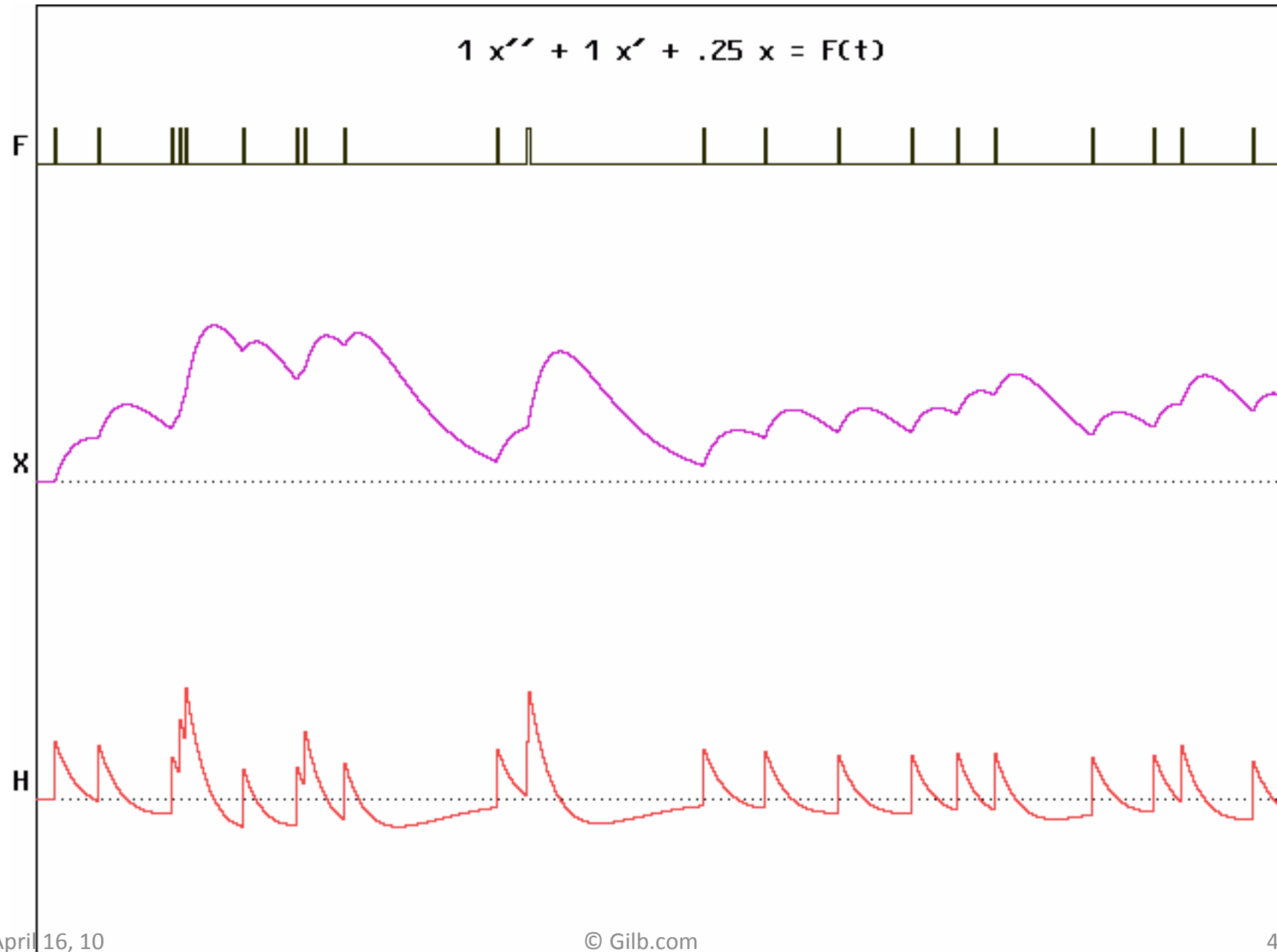
Winning the Lottery



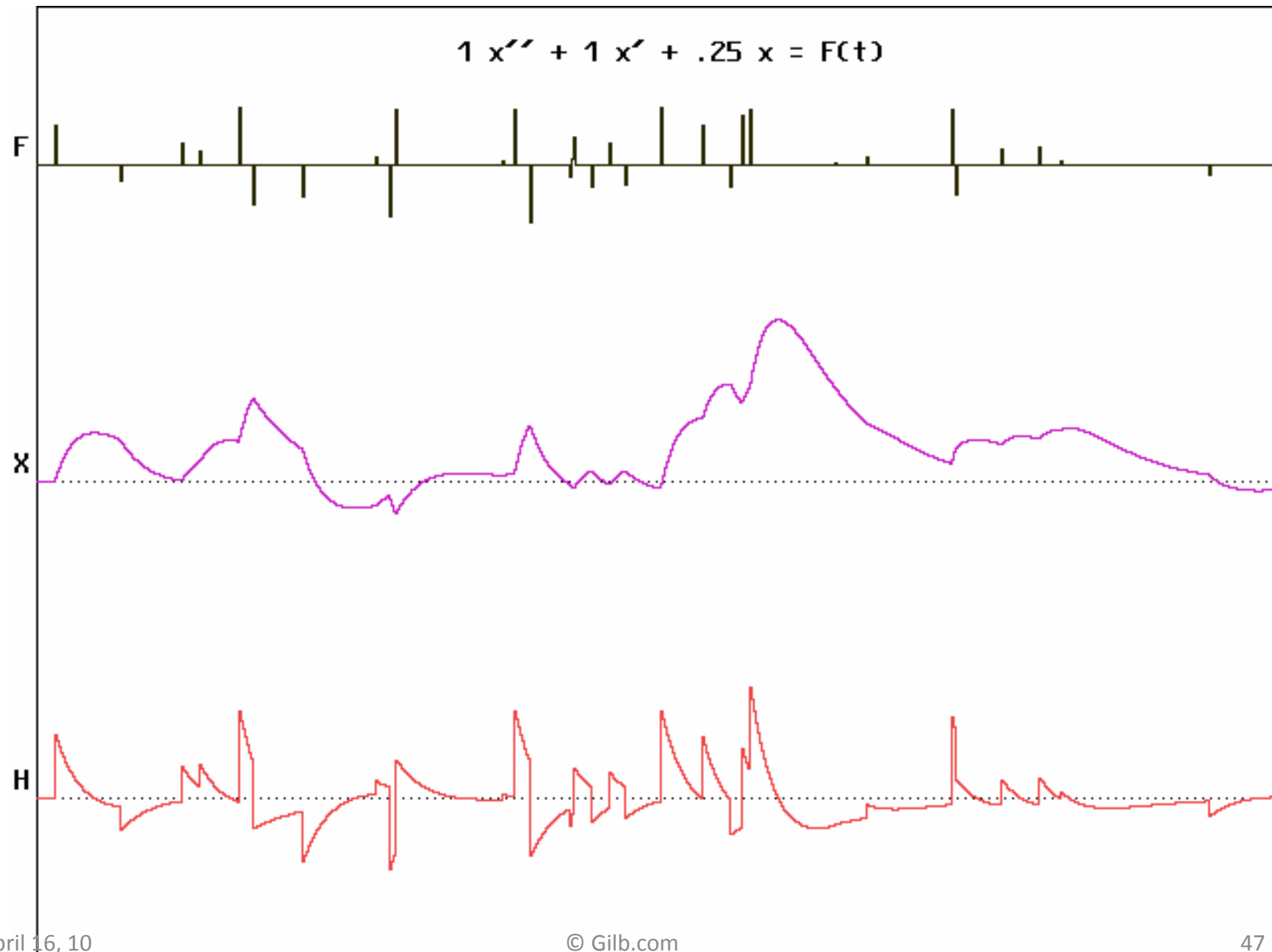
Drug or Other Addiction



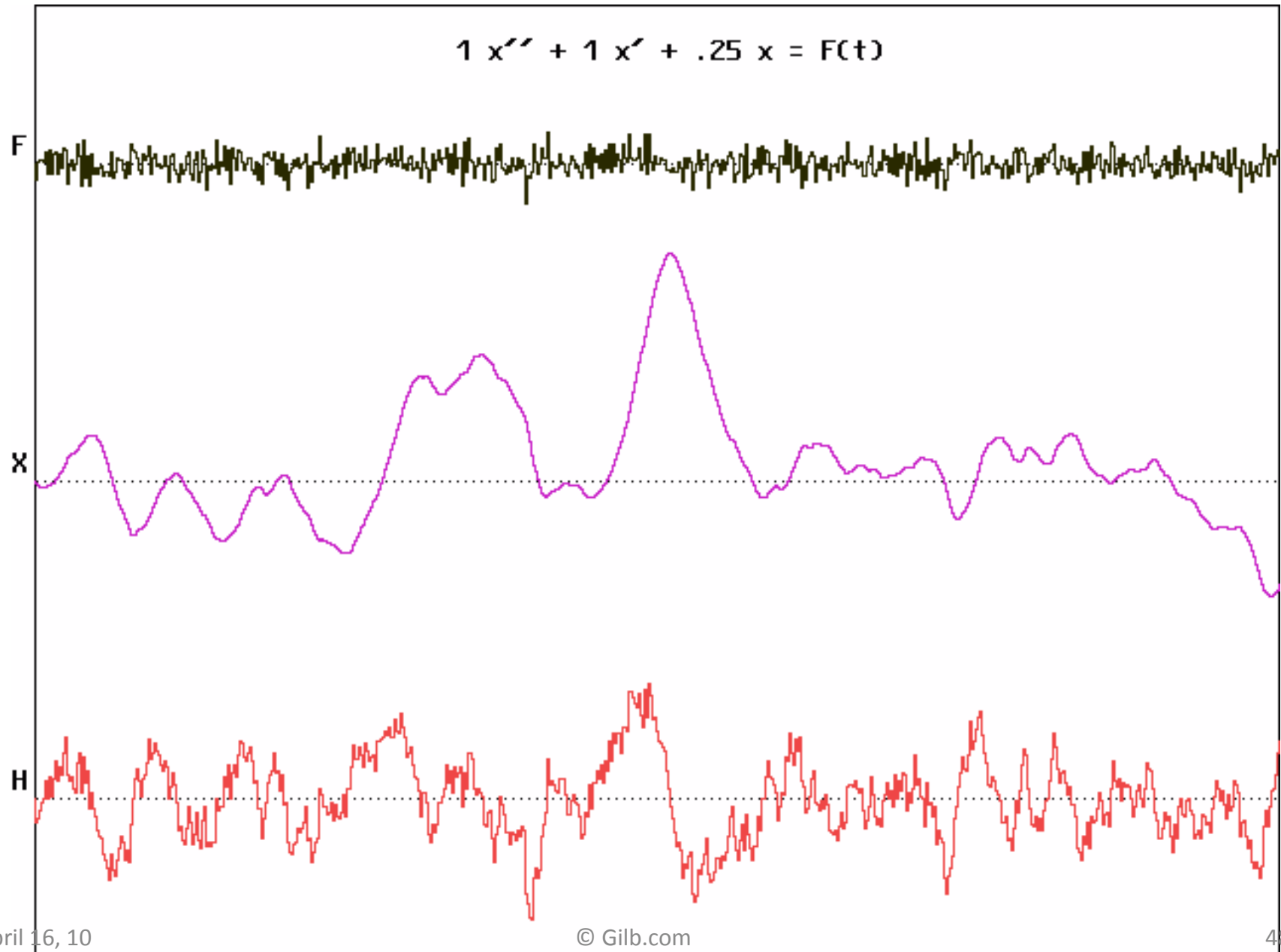
Intermittent Reinforcement



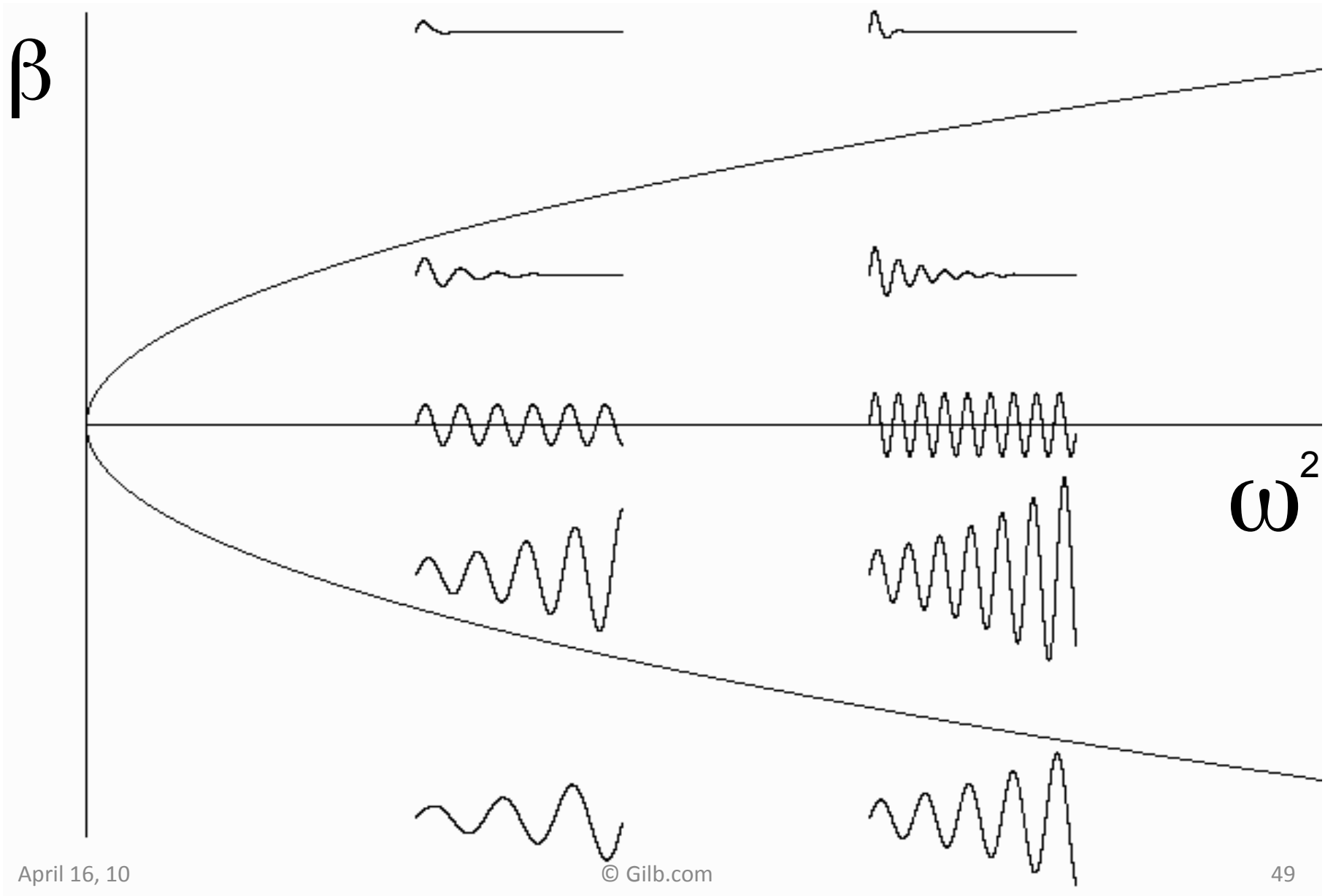
Random Events



Real Life



Parameter Space



Some Implications

- Constant happiness is an unrealistic goal.
- Others see less volatility in you and often wrongly conclude how you feel.
- Individuals can be categorized by their values of β and ω .
- Manic depression may correspond to $\beta \sim 0$.
- Long prison terms may be ineffective.

A few other happiness studies

- Brickman, Coates & Janoff-Bulman (1978) report only small differences in life satisfaction between paraplegics, control subjects, and lottery winners.
- Lykken (1981) reports that religious people are not noticeably happier than freethinkers.
- Diener & Diener (1996) review studies indicating that all American socioeconomic groups score above neutral in life satisfaction, as do people with severe disabilities.

What disabilities, you ask?

- Hellmich (1995) reports that 84% of individuals with extreme quadriplegia say that their life is average or above average.
- Delespaul & DeVries (1987) report that people with chronic mental problems claim positive well-being.

As for the dynamics

- Silver (1982) reports that individuals with spinal cord injuries are very unhappy immediately following their injury, but that 58% state that happiness is their strongest emotion by the third week after their injuries.
- Suh, Diener, & Fujita (1996) report that good and bad events have almost no effect on happiness after 6 months.

In Summary ... (Lykken 1999)

- There seem to be no permanent ups and downs; natural selection has made us this way, because, by accommodating to both adversity and to good fortune in this fashion, we remain more productive, more adaptable to changing circumstances, and more likely to have viable offspring.

Other Similar Qualities

- Sense of wealth
- Health
- Intelligence
- Skills
- Senses
 - hot/cold
 - smell
 - vision
 - hearing ...

Summary

- Love and happiness are wonderful
- So is mathematics

References

- <http://sprott.physics.wisc.edu/lectures/love&hap/> (This talk)
- Steven H. Strogatz, *Nonlinear Dynamics and Chaos* (Addison-Wesley, 1994)
- sprott@juno.physics.wisc.edu