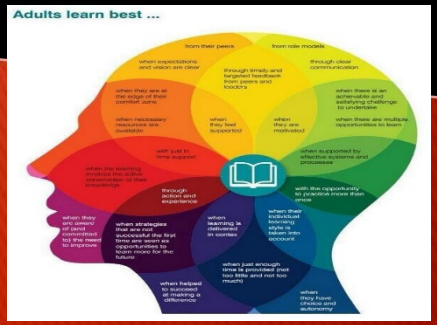
Learning to learn circuit analysis

B.J. Shrestha, Ph.D.



Dedication

- To my dad

- – Professor Kalidas Shrestha

- http://thehimalayantimes.com/entertainment/events/eminent-artist-kalidas-no/

acknowledgement – gratitude

- to many good people
- and
- good things
- –wait for the last slide

Circuit Analysis I and II

- EE 2100 & EE 2120
- Various laws and their applications
- Kirchhoff's Current Law,
- Kirchhoff's Voltage Law,
- Ohm's Law, …..
- Full of laws and theorems – Too many if you ask the students

So, the BIG question is …

How do you

inspire

or

help

these students to learn all of these laws, theorems and their applications?

Such a BIG question !

So, what is the answer

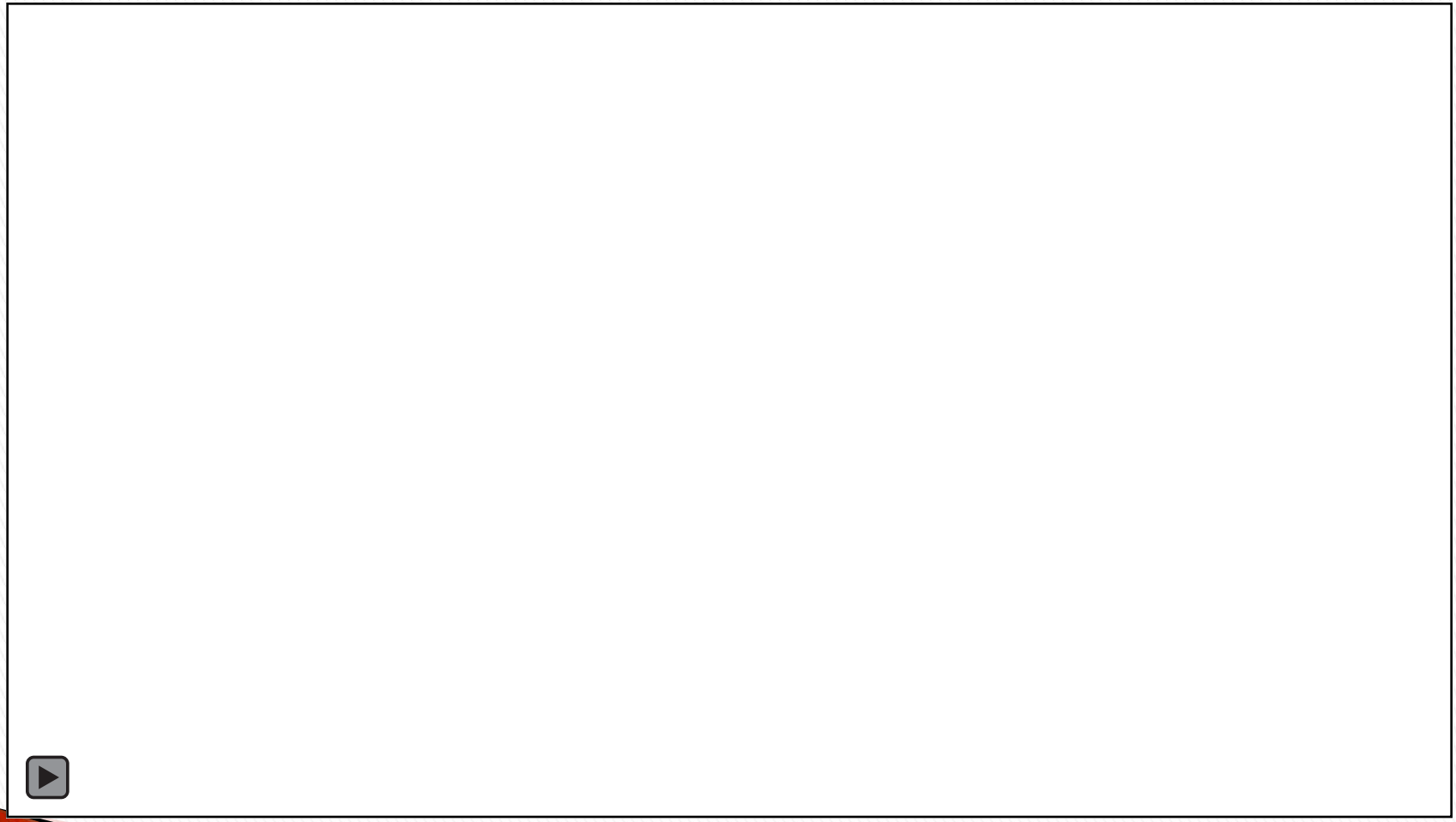
?

Perception about this course

- or perhaps
- many other courses …

hard course – difficult to pass – dry, no fun ..

possibly, a weed-out course !



However, these challenges are pretty generic ..

Many courses have similar challenges.

- My quest here is to bring forth innovative class dynamics to help create best practices to help our students learn the most.

my aspirations is driven by

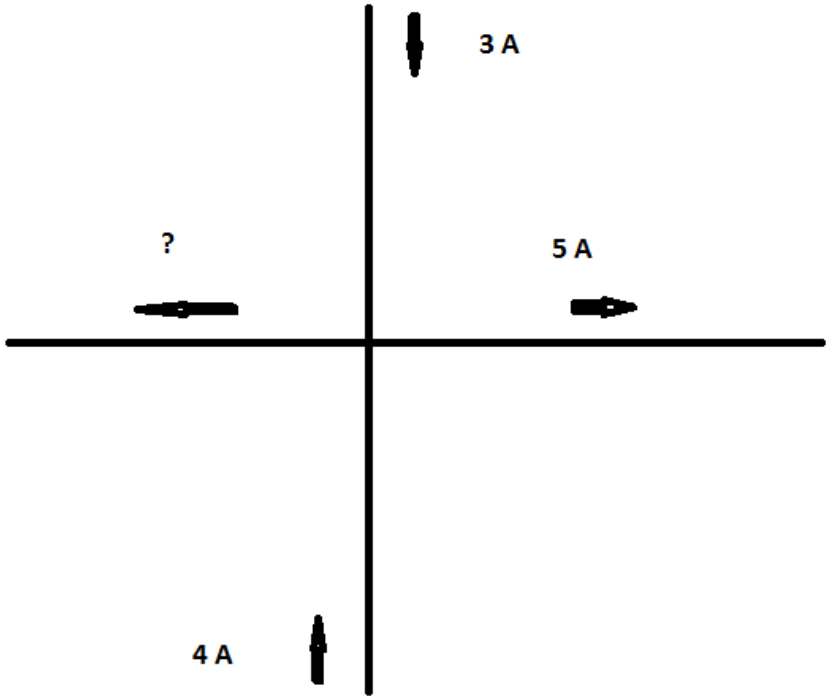
- **a desire which is perhaps common to many of you in many other courses**

- to help our students learn the most

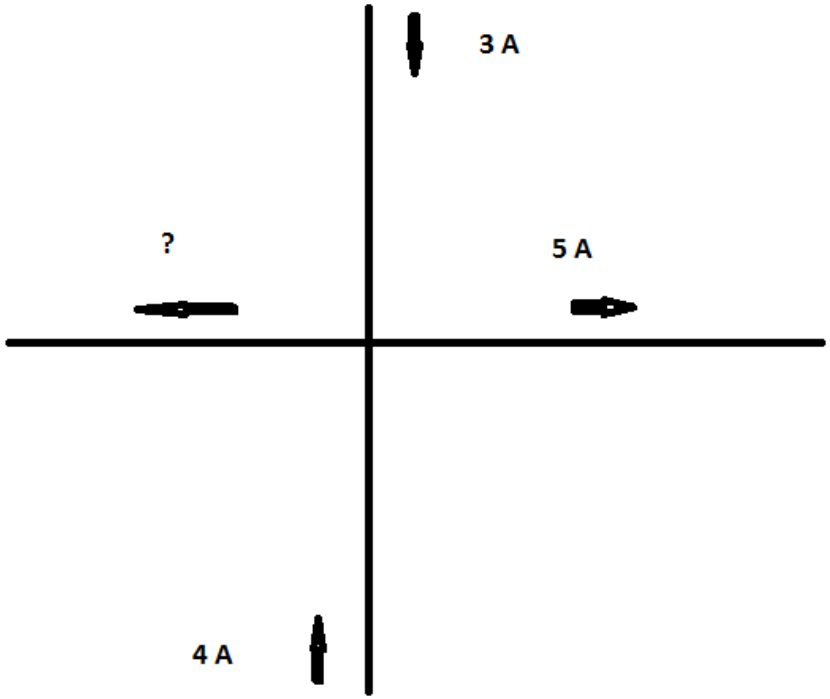
FOCUS of my PRESENTATION !

Learning techniques based on

- **Thrills of Discovery**
  - Enhanced Discovery Learning
    - – example –
      - **KCL**
  - (Kirchhoff's Current Law – Gustav Kirchhoff)



How much is the current coming out ? »



Total current going in = (3+4) A = 7 A

Total current leaving = (5+ ?) A So, ? =

Discovery

- – now they know !
- Total current going in = Total current leaving
  - $\Sigma I_{in} = \Sigma I_{out}$
- – without telling them, we helped them discover the famous

KCL (Kirchhoff's current law)

Discovery

- – let them discover the rules, if possible
- – try not to hand them down
- – don’t give the formula right away,
- – it’s tempting though

Learning techniques based on

- **Finding Pattern**
  - Pattern Recognition
    - – example –
    - **Ohm's Law**
    - (George Simon Ohm)

Learning techniques based on

- **Finding Pattern**

# of observation	Voltage (V) volt	Current (I) milli amp	Is there any Pattern?	Inference
1	2	0.5		
2	4	1.0		
3	8	2.0		
4	16	4.0		

Learning techniques based on

Finding Pattern

# of observation	Voltage (V) volt	Current (I) milli amp	V/I (R) Kilo ohm	Inference
1	2	0.5	4	Constant
2	4	1.0	4	Constant
3	8	2.0	4	Constant
4	16	4.0	4	Constant

V/I = Constant for a fixed conductor
Ohm's Law

Learning techniques based on

- **Finding Pattern**

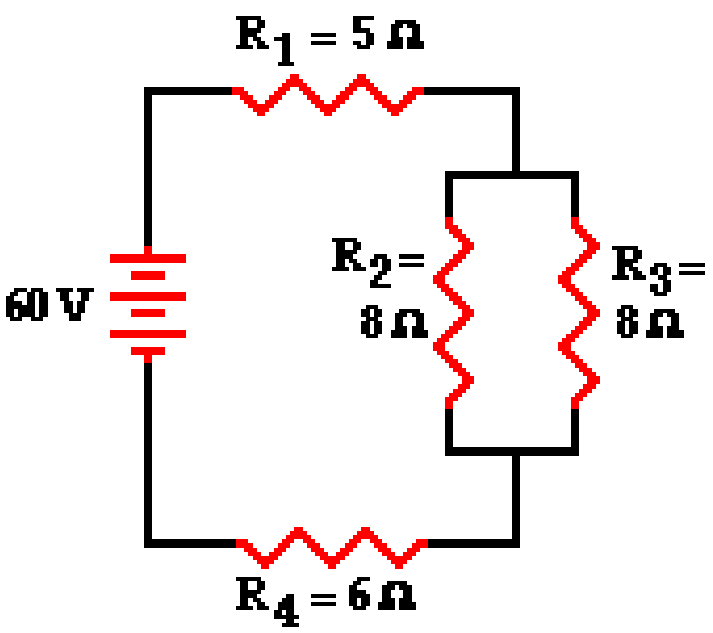
V/I = Constant for a fixed conductor

- **Ohm's Law**
- (George Simon Ohm)

Learning techniques based on

- **Many Paths**
  - One destination
    - – example –
  - **KVL/Divider Rules**
  - **MC/NV methods**

Learning techniques (Many Paths)



R_{tot} = _____ I_{tot} = _____

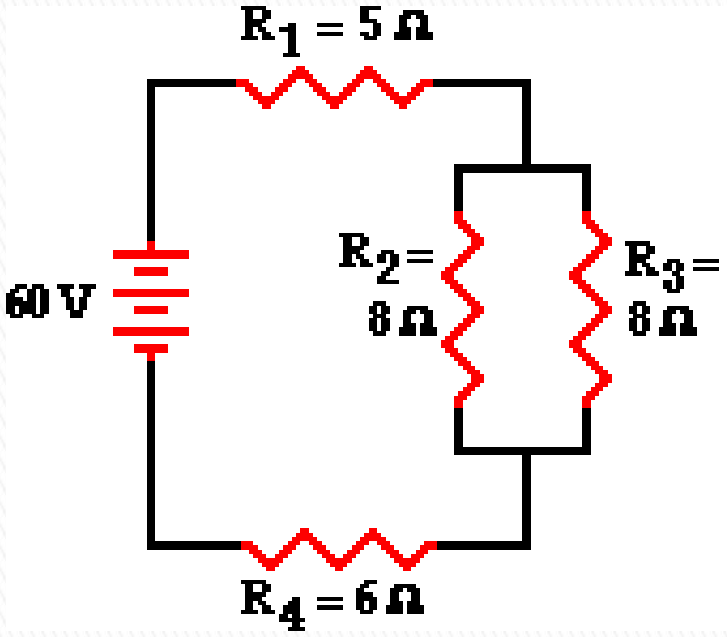
I_1 = _____ ΔV_1 = _____

I_2 = _____ ΔV_2 = _____

I_3 = _____ ΔV_3 = _____

I_4 = _____ ΔV_4 = _____

Learning techniques (Many paths)



$R_{tot} =$ 15 Ω

$I_{tot} =$ 4 Amp

$I_1 =$ 4 Amp

$\Delta V_1 =$ 20 V

$I_2 =$ 2 Amp

$\Delta V_2 =$ 16 V

$I_3 =$ 2 Amp

$\Delta V_3 =$ 16 V

$I_4 =$ 4 Amp

$\Delta V_4 =$ 24 V

Learning techniques based on

- **Repetition & Reflection**
  - Reinforcement of Knowledge
    - – example –
  - **Read, Recall, Review, Recap, Recite, Reflect, Repeat**
    - (Wow – all the good R's !)

Learning techniques based on

- **Working under Pressure**
  - Thrills of Challenge
    - – example –
  - **Solving a problem in a limited amount of time**

Learning techniques based on

- **Group Identity**
  - Sense of pride
  - – example –

Group activities – perform the task as a team

Learning techniques based on

- **Enjoying**
  - Element of Chance
    - Lottery Box
    - – example –

Learning techniques based on

- **Enjoying**
  - The keyword here is “Enjoyment”

Learning techniques based on

- **Brain Storming**
  - Coming Together
    - – example –

Learning techniques based on

- **Playing Games**
  - Even just the word triggers fun
    - strategies
    - – example –
      - **KCL**

Learning techniques based on

- **Playful Use of Phrases**
  - Having fun with words & concepts
    - – example –

- **Only the lonely** – Use one source only when applying Superposition principle.
- **Diamonds are forever** – when you eliminate sources, the diamonds stay, they can't be killed.

Learning techniques based on

- **Playful Use of Phrases**
  - Having fun with words & concepts
    - – example –

- **Let the kids go** – Low Pass Filter.
- **Let the teens go** – Band Pass Filter.
- **Let the adults go** – High Pass Filter.

Learning techniques based on

- **Judgement**
  - Engineer's eye balling
    - – example –
    - **Common sense**

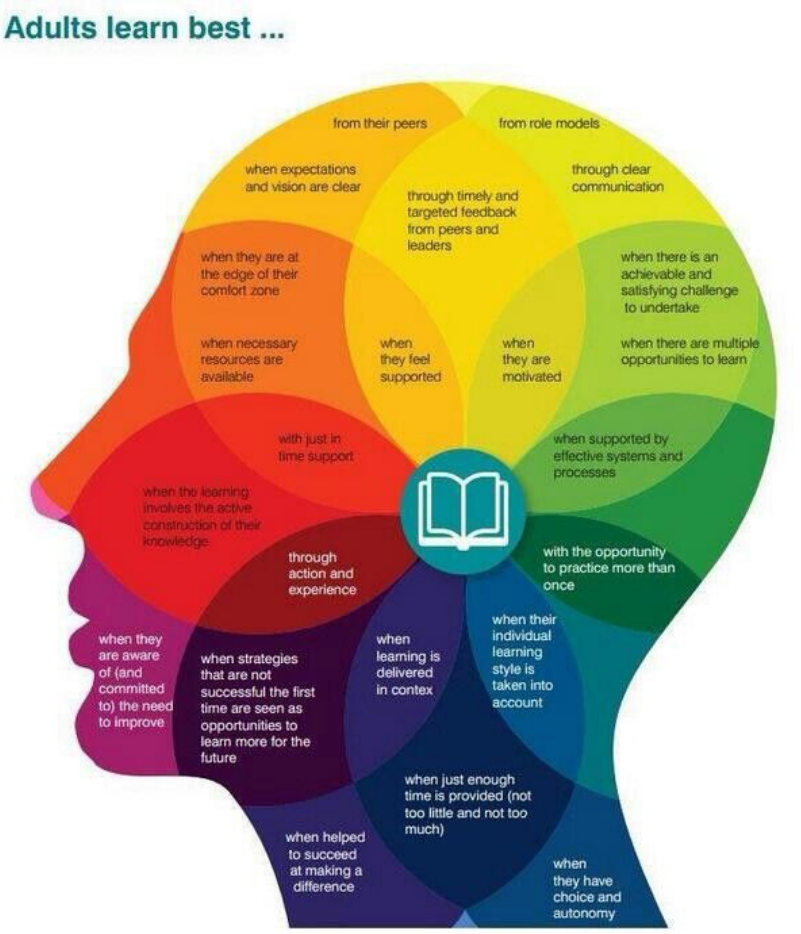
Learning techniques based on

- Examples of road crossing, roundabouts
- Circuit networks, nodes, loops, path to avoid, etc

Learning techniques based on

- **Are we done?**
  - Not done listing yet
  - Open ended possibilities

Learning techniques based on



Learning techniques based on

Once again back to the same issue,

this course is a requirement … (!)

- Now that
- – triggers negative emotions
- – unless ..
- – something is done to change their perception

Perception … (?)

- So far, the perception is that the course catalog has required them to take the course but denied the joys of engagement, not on purpose, but …

- that is the crux of the problem !

Need –

* a new pedagogical approach to involve students actively in the teaching – learning process

* reward them for their initiative and involvement

* give them a venue where genuine conversation takes place

* guide them to discover the connecting dots of their endeavor to their desired goals

Problems ?
–
Lack of engagement
Lack of relevance

A P A T H Y

Solution

- Engage the students

- Help them realize the relevance of the course
- Have them connect the dots …. ….. ….
- Give them a direction but let them find it

- Reward their discovery of the connection

Empower

- Empower them by awarding their leadership and involvement.

But first,

Let them see how this course is relevant to their chosen field of study …

What they feel right now is

Chained to some unpleasant course …

Disconnect …

Dissatisfaction …

Powerless …

Unmotivated …

Way out –

Calibrated peer-instruction

Students learn more when they have to teach others what they have learned

Circle of learning process –
knowledge, articulation, and implementation

Problem based learning

- teams are formed of students

- they are handed pre-assigned list of problems/tasks

- following a schedule, they take turns to teach peers in the team about how to solve a problem

- explore alternate paths to solve the problem and weigh pros and cons

- they receive points for such an activity

Way out –
Wikis on the go

- Face-book, Twitter generation:

  – Social media – comfort zones for the bulk of our students

  – Use this techno-savvy culture to increase the engagement effectively in the class room

  – students are asked to post course related assigned topic as a wiki post within the "Blackboard" where their peers are encouraged to comment on each other's work

  – they receive points based on their activity

Return

- – enhanced exchange of ideas – horizontally across peers besides vertically with the professor

  * Getting them do the tasks they are socially more comfortable doing is the key !

  * Students do better when they feel emotionally and intellectually safe – this gets everyone on the bus.

Return

* wikis have become a place where the students can really show off and they love it

* encouraged to add graphics, audio/videos clips to enhance the presentation

* instills the sense of being techno-savvy – builds confidence

* encourage students to examine case studies where they investigate how the circuit theory they are learning in the class is applied to solve a real life problem, for example, “Using resistance to measure the strain”, etc.

* They receive points for presenting these cases

Way out –
Learning by playing

- Occasional "Jeopardy-like:" game playing can provide additional intensity in the engagement process

  * Students feel more energized in the face of the idea of a game

  * Study sounds burdensome and tiring while the words "game" or "playing" bring out all of the positive emotions

  * Trick is to transform a study session into a game-like activity without losing its core values

  *learning occurs without having to carry a burden of chore.

Way out –
Old tools of the trade

* combine new technology with old tools of the trade

*regular exam and final exam – traditional tools – don't eradicate them, balance them with the new set of activities

* another problem – decline in attendance

* Allocate attendance points (less than 10% of the total)

* Notion of "Just showing up to the class bring some points" does a good trick

Way out – Striking a balance

* Good balance – key to success

* Overall grade distribution is spread over various parts of the methodology to keep a good balance

Hype

- Change the hype behind the notion of homework assignment

  *a homework is not done when you calculate the answers, not yet..

  * it is done when you go back and see
    if the answer makes sense,
    if the little pieces fit the big picture …

  when it does, it ceases to be a work, it becomes a pleasure

Just a sec …

- **The trick is to make homework assignment not feel as a chore.**

A chore takes all the fun away …

Make it feel like anything but work …

Methodology

- 1. Calibrated peer instruction
- 2. Wikis on the go
- 3. Learning by playing
- 4. Old tools of the trade
- 5. Striking a balance

Learning outcomes

- **students when trusted and allowed to explore tend to engage in the learning process**
- The methodology described here is pragmatic and is transformational in nature

Get Ready for engagement & excitement

Excitement builds expectation and engagement helps us meet them

appropriate technology

- Use technology as a great tool

- to reach out
- to excite
- to empower
- to let them feel .. that they've got it

- help'em build their confidence

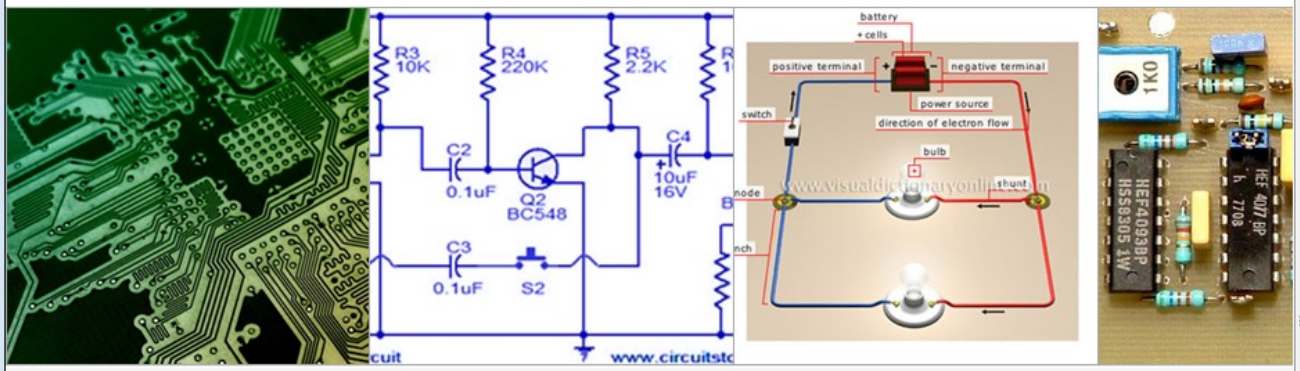
advice

- Use wiki posts
- Use tutorial sites or build one
- I built one for circuit analysis

drshrestha

Font size Bigger Reset Smaller

Search...



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Create an account

Welcome

Welcome to drshrestha.us.

Phone: 573-341-6068
Fax: 573-341-6671
shrestha@mst.edu

Research Interests:

Photon transport in semiconductors, Statistical Physics, Monte Carlo Techniques, Neutral particle transport algorithm development, Neutronics and Photonics, Medical applications, Computer vision and Image processing, Feature extraction and identification

Use gadgets

- interactive white boards
- iPhones
- iPads
- video podcasts
- use music, as appropriate
- use interactive exercise

- be prepared to learn yourself as you “go”

Look where we are – assessment

- Knowing where we stand
- Belief in limitations – blocks
- Logical block
- Emotional block
- Moral block
- We build expectations and meet them by breaking these blocks.

Blocks

- Society constantly pulse suggestions about our capabilities, and these suggestions underestimate what we can be.

- Belief in limits creates limited people. We can fly, but that cocoon has to go.

blocks ..

- Many of the strands that bind us are unconscious suggestions.
- From the moment we are born we begin to pick up suggestions from those around us on how to act and what we should be like.

blocks ..

- we have to overcome our preconceived ideas about the limitations of our personality and abilities

Three big rocks or .. blocks »

Three Big Blocks

- Logical Block
- Emotional Block
- Ethical Block

The logical block

- “its not for me, I could never do it because I’ve never done it”

- some people are skeptical to try anything new

The emotional block

- – someone might have said at some point, “You certainly are hopeless at Mathematics”.

- –this negative suggestion may have been accepted at face value by a student who then proves it to be true.

The ethical block

- – many people are conditioned to feel that learning has to be hard work, drudgery, and painful.

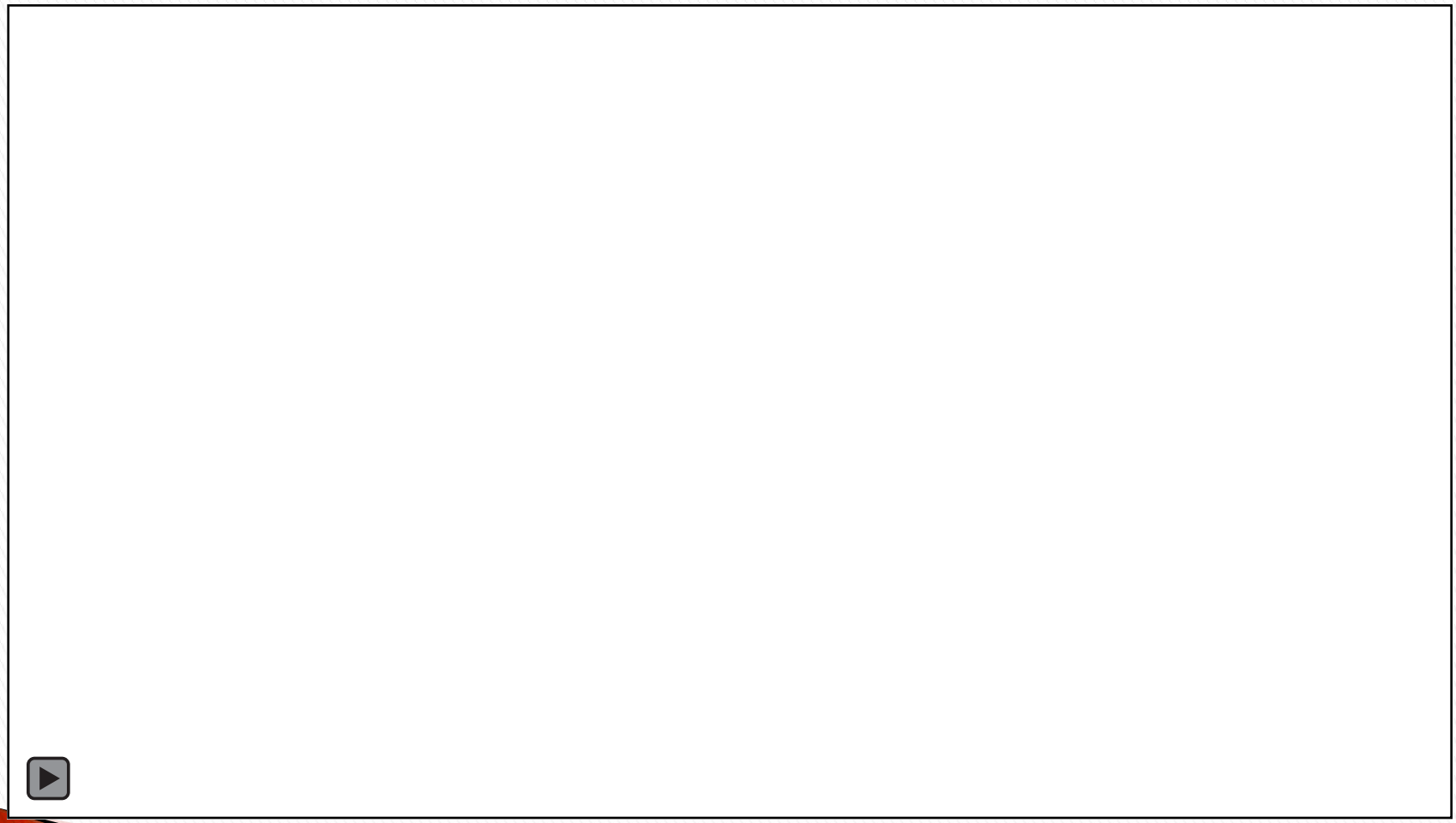
- –in fact, gaining knowledge is quite joyful.

JOY IN LEARNING

- Life should be a stream of happiness and yet the lives of many people are full of fears, fear creates tensions and poisons the climate of one's life.

- Many of us are victims of methods of education.

Joy in learning is a basic tenet of a good learning system.



Joys of learning

- – small children have this joy naturally; if they didn’t they would never learn to walk, talk or feed themselves.

Useful rules

- 1. Meaningful
- 2. Efficacy
- 3. Support
- 4. Group work
- 5. Positive Relationships
- 6. Mastery of materials

Meaningful

- Students need to feel the learning activity to be meaningful for them, if not, they might not engage in a satisfactory way

Efficacy

- "Can I do this?“
- – to help foster students' sense of efficacy in learning activities, encourage them and provide feedback that helps them make progress.

Support

- Welcome students' opinions and ideas into the flow of the activity

Group work

- When students work effectively with others, their engagement is consequently amplified, mostly due to experiencing a sense of connection to others during the activities.

Positive Relationships

- Positive teacher-student and student-student relationships are key factors in enhancing student engagement
- Builds trust and a sense of comfort

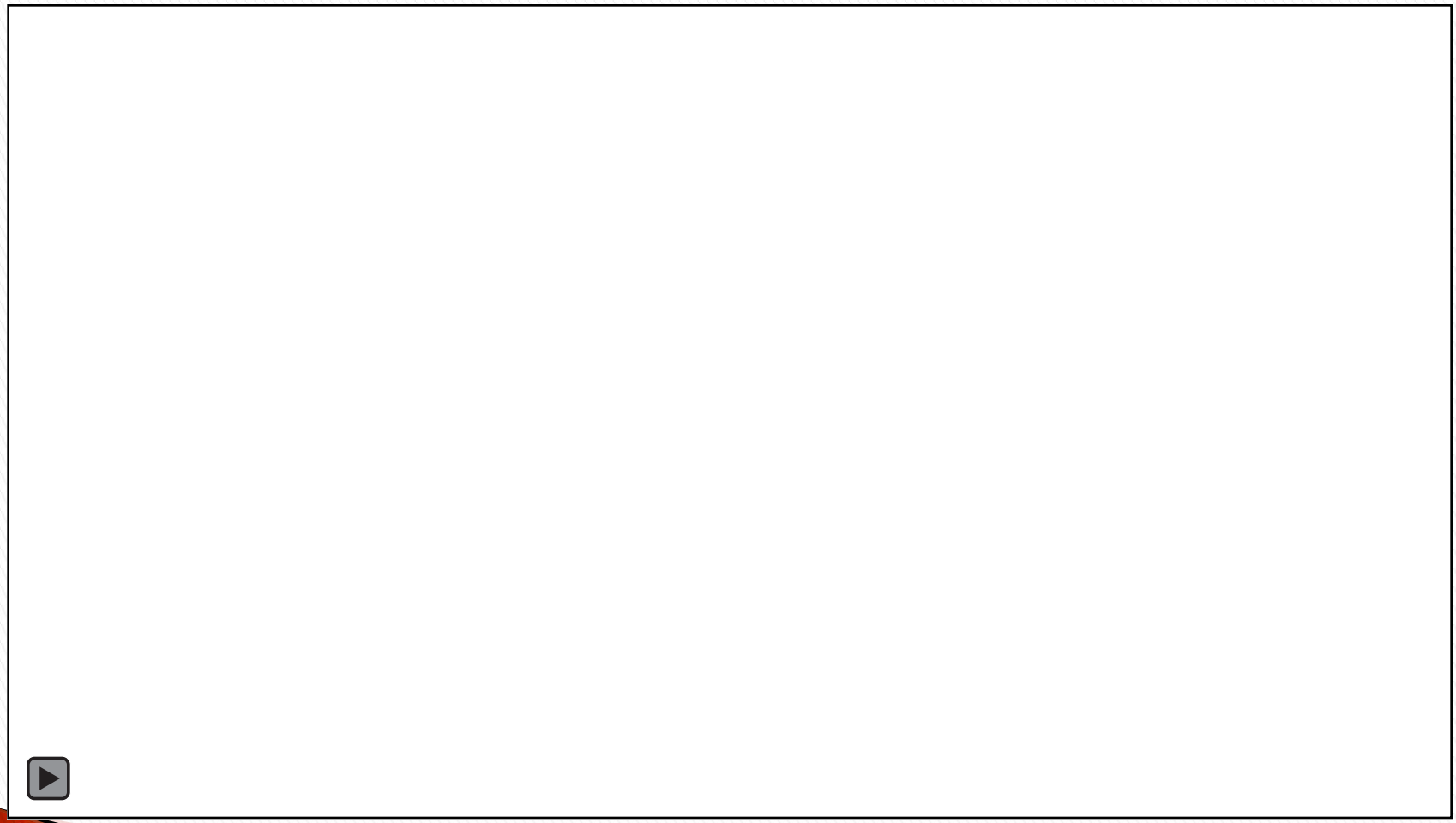
Mastery of the material

- When students pursue an activity because they want to learn and understand, their engagement is more likely to be full and thorough.

about your students ..

- let them show off – wiki posts
- let them be peer models
- let them lead – at times

Let them grow – naturally !



at the end ..

- it's the …
- joys of teaching
- helping the students succeed
- hopefully, helping create a better world

- Bring it home

Bring it home !

Get Ready to Celebrate!

Learn more by teaching

Mathematical modeling

- Student's initial attitude – state function
- $|s_{initial}\} = |s_i\}$ (A.1)

- Educator – agent of change – Operator
- $\bar{O}\ |s_{initial}\} = |s_{final}\}$ (A.2)

- Representation
- $\{ s_{final} | \bar{O}\ |s_{initial}\} = \{ s_f | \bar{O}\ |s_i\} = T_{if}\ \beta_{if}$ (A.3)

- $\beta_{if} = 0$ for $i = f$ and $\beta_{if} = 1$ for $i \neq f$ (A.4)

- Incremental transformation
- $T_{if} = T_{ia} + T_{ab} + T_{bc} + \ldots\ldots + T_{zf} = \Sigma\ T_{jk}$ (A.5)

- $|s_p\} = \Sigma\ c_n\ [|s_i\}]^n$ (A.6)
-
- –

Mathematical Modeling

Mathematical Modeling

Mathematical Modeling

- An attitude of a student can be represented by a state function (a mathematical function that represents the state), $| s_{initial} \}$ or $| s_i \}$, in short, which may be dependent on host of other parameters, such as educational background, e (in short for educational), cultural background, c, incentives, i, perception, p etc.

Mathematical Modeling

- In other words, once the attitude $| s_i \}$ is operated by the operator, $\bar{O}$, it changes the attitude $| s_i \}$ to an attitude $| s_f \}$. Such a transformation may be expressed mathematically by a transformation function, T_{if}, as given by, equation (1) below:

Mathematical Modeling

- $T_{if} = \{ s_f \mid \bar{O} \mid s_i \}, \quad i \neq f, \quad \beta_{if} = 1$ (1)

Mathematical Modeling

Mathematical Modeling

- Our desire here is to realize that equation (1) captures our aspiration as an educator, meaning that the agent of change, Ō. will transform | s_i } to the desired | s_f }. Here, we also see a new parameter, β_{if} .

Mathematical Modeling

- The construct of a meaningful T_{if} for an existing set of parameters {e,c,i,p, … …} is the ultimate goal to effect the desired change.
- From the eyes of a traditional sit-in class, the T_{if} required in an online class involves a different trajectory.
- **It really needs a shift in the paradigm**

Mathematical Modeling

- To recap

Mathematical Modeling

- Student's initial attitude – state function
- $|s_{initial}\} = |s_i\}$ (A.1)

- Educator – agent of change – Operator
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-

Mathematical Modeling

Some advice to the students

- Enjoy the learning process
- Know that there may be more than one way to solve a problem
- Articulate your ideas without worrying if some one would ridicule it
- When you teach some one how to solve a problem, you do two things at one time – earn a great friend and reinforce your own knowledge.

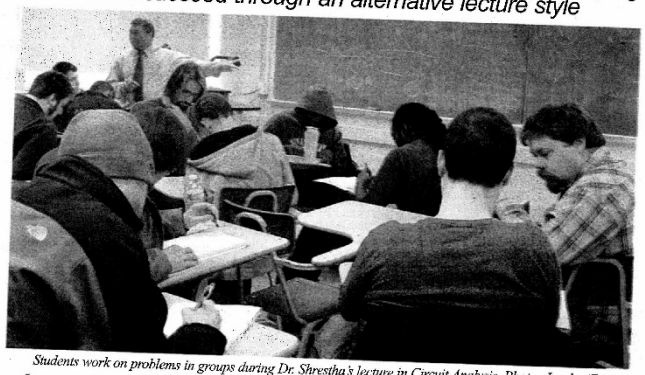
Excerpt from Missouri Miner

The Missouri Mi

Volume CVI, Number 19 ..... Serving the Missouri S&T public since 1915 .....

ALTERNATIVE LEARNING:

How one S&T professor is encouraging students and helping them succeed through an alternative lecture style



Students work on problems in groups during Dr. Shrestha's lecture in Circuit Analysis. Photo: Jocelyn Esparza

Jocelyn Esparza
News Writer

Learning and succeeding at Missouri S&T can be wrought with many tough obstacles. Students, especially those in engineering disciplines, have to learn mostly in a standard classroom, listening to a lecture, about topics that may actually be better learned in more of a hands-on approach. With the exception of labs and seminars, too few classes stray away from the style of a classroom setting. Students will come into class, take notes on a teacher's demonstration or lecture, and study on these notes, trying to commit them to memory. Dr. Shrestha's classroom is not this typical lecture-style setting. Last Friday, I was invited to sit in and observe his circuit analysis class. Here, I was able to experience firsthand his different teaching method, combining his lectures with a holistic group-learning environment. Students are actively involved in the lecture, not just sitting idly watching him teach. Dr. Shrestha writes problems on the board, with students broken into assigned groups, solving their problems and writing on them on a board to compare answers with their peers. A healthy dose of public display sparks competitiveness with the students, and encourages more active learning. If a group member knows the answer before their peers, they are allowed to write the answer on the board, and are encouraged to share their knowledge to teach their classmates. Being able to sit in, I was able to experience the relaxed environment, where peers felt no discomfort, and the sharing of knowledge was abundant.

Dr. Shrestha is an Associate Teaching Professor in the Department of Electrical and Computer Engineering, having received his Bachelors and Masters in Science from Tribhuvan University in Nepal. He

LEARNING cont. page 4

Feb 26, 2015

LEARNING cont.

received his PhD in Nuclear from Missouri S&T in 1995. This year marks his twentieth year of teaching at Missouri S&T. He gives the credit for his introduction of this new teaching method to his students. "I always think about the ways I could teach my students so they learn the most, and I have found that keeping them actively engaged in the learning process is the key. I use student-centered strategy and problem-based learning techniques. Brainstorming on problems is my method of helping my students discover solutions to various types of problems. I encourage them to see if there is more than one approach to solve a problem, usually there is. I have been teaching throughout most of my life. I am very humbled by the opportunity to teach my students, it is my chance of leaving our world a little better in their hands."

One of my favorite aspects of sitting in was what he had written on the board. He had many notes and problems, but two sections stood out. He had written 'Goals Today' and 'Advice' with goals that stude should accomplish for the c and a piece of advice that he mattered for that particular cl period. When I asked Dr. Shres what advice he would give his s

> "Enjoy the learning proces keep an eye to find more tha one way to solve a problen articulate your ideas witho any fear whether they woul be ridiculed by your peers"

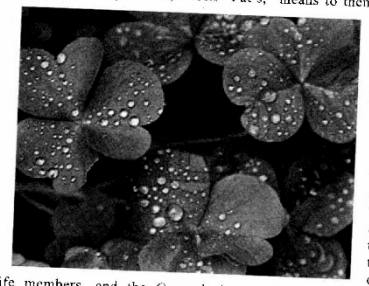
St. Pat's preparations well underway with only

Steve Rusakiewicz
News Writer

With February drawing to a close, many students on campus have turned their attention to the imminent festivities that await them during the famous St. Pat's Celebration here at Missouri S&T. The festival itself is only 10 days, but the planning goes on all year long in order to ensure that every St. Pat's Festival put on by the board is the "best ever St. Pat's."

The planning for the festival involves about 30 student board members and around 10 faculty from various departments who are responsible for execution of the festival's main functions and activities. This is a significant reduction in manpower from the 70-80 members who would plan without a hitch during the 10-day event.

The membership within the St. Pat's board is described by Jason Pelliccione as, "a melting pot between Independents, Greek life members, and the General



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February 26, 2015

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> "Enjoy the learning process, keep an eye to find more than one way to solve a problem, articulate your ideas without any fear whether they would be ridiculed by your peers"

One of my favorite aspects of sitting in was what he had written on the board. He had many notes and problems, but two sections stood out. He had written 'Goals for Today' and 'Advice' with goals that students should accomplish for the day, and a piece of advice that he felt mattered for that particular class period. When I asked Dr. Shrestha what advice he would give his students, he responded with the following advice. "Enjoy the learning process, keep an eye to find more than one way to solve a problem, articulate your ideas without any fear whether they would be ridiculed by your peers, teach and help each other and learn more by teaching." However, the words that I personally took to heart were "realize the fact that when you show how to solve a problem to someone: you do two things at once, you earn a great friend, and you also reinforce your own knowledge."

rations well underway with only two weeks to go

without a hitch during the 10-day event.

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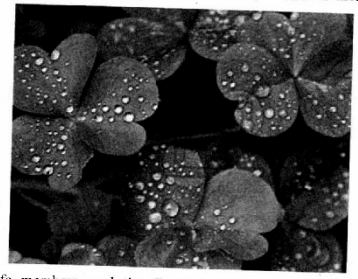

their sponsorships. Overall, the membership of the board is as diverse as the interpretations of the festivities themselves.

When generally asked what St. Pat's, "means to them," students respond with an array of interpretations ranging from merely "letting off steam," to "getting absolutely tanked," to "a time of bonding and competition between celebrations is the development of deeper ties between friends, colleagues and faculty.

Considering the multidisciplinary makeup of the St. Pat's Board, as well as the monumental project they are responsible for directing every year along with the incredible opportunities that exist in the areas of public-relations and professional networking, any student who applies themselves diligently to this team of dedicated people will no doubt find themselves personally and professionally better off for the experience. This circumstance being held evident, students who are able to put the time into St. Pat's are certainly encouraged to do so. Aside from being an integral part of a century-long tradition of celebration and friend-

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Any question ?