Intellectual Leverage in an Information Society

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OPEN

Thank you - - , and thank you folks. It's a great pleasure to be here with you today. In this talk, rather than present the details of a particular technology - - I'll instead present some ideas I've found useful when attempting to innovate new technology - - - in particular, we'll focus on how we can apply the intellectual leverage afforded by existing information technology towards the generation new technology.

IDEA

Advances in computer hardware, in computer networking, and in software environments and applications, now make it possible for individuals and small groups to accomplish tasks that were difficult if not impossible in the past. Taken together, many of these advances can be visualized as "intellectual multipliers or levers" that is, as tools that enhance and leverage our analytic, creative, and communicative powers.

UTILITY

As computer scientists and electrical engineers - - the creators of this new technology - - we're among the first to be fully immersed in it - - to fully experience it. So maybe we have an added opportunity here - - perhaps if we reflect on and share some of our experiences, we can understand better how to create - - and how to apply the intellectual leverage - -

SOME QUESTIONS:

- Where does the leverage come from?
- How can we better explain it to others?
- How can we create more leverage?
- How much more can we create?

let's keep in mind

QUESTIONS

During the talk, ~~we'll consider~~ the following questions: ~~First~~ - **Where does the intellectual leverage come from?** In what does it consist?

Can we find ways to better explain it to others? - perhaps some metaphors and stories that capture key ideas - that's often a good way to better understand things ourselves.

As we find some insights and some explanations, we then might wonder: **How can we create more leverage?** What methods can we use to make some more of it?

And - **How much more can we create?** What might be the limits to this frontier?

WHERE DOES THE LEVERAGE COME FROM?

- Augmentation of individual intellects. (But is that all it is?)
- What makes tomorrow different from today?
- Genesis and propagation of innovations in groups.
- Stories providing insights and metaphors.

INDIV. LEVERAGE

Where does the intellectual leverage come from?

Many of us are used to using machines at home and at work, using electronic mail, working in group projects in the networks, etc. So it's easy for us to see how our information technology leverages what we can do as individuals - - by boosting our analytic, creative, and communication skills. We can simply measure how much faster we can calculate, or compute, or explore alternatives - - how many more people we can interact with, independent of location, in the networks. We can measure that kind of leverage.

esp in tech/prof work

Q?

But we also see giant social changes being caused of our technology - - can we explain the large rate of social change by just adding-up the effects of a lot of individuals being leveraged? Is that all it is? Or is there something larger, deeper going on? - -

How do social changes happen?

CHANGE

How does culture change anyways? - - **what makes tomorrow different from today?** How can we think about that? - - Suppose we each did the same mix of things from day to day - - then the world would appear to stay the same - - our culture would be a stable form. Instead we each gradually change the mix of things we do, adding new ones, deleting old ones. That too might produce a stable form, if we just rotated things around among us. But we go further - - we occasionally innovate new artifacts, new behaviors - - some of these new things propagate through the culture. If the rates of innovation and propagation are large, our world changes a bit from day to day - -

TECH. EFFECT

We've already noticed how our technology gives each of us some new powers - - so we might discover how to do something that wasn't possible before - - not just do the same thing better, but do something different, something innovative - - But - - have we noticed that our technology can ALSO speed-up the propagation of our innovations - - by providing better paths for observing and communicating things. Maybe THAT'S what behind the dramatic social changes - - something in the combinatorics and accumulative effects of technology on both the **formation and diffusion of innovations in social groups** - - this is the area I'd like to explore in the rest of the talk - -

Q?

But what is an innovation anyways? In what does it consist? - - how do innovations diffuse? - - how can we develop intuitions about such things? - - I'd now like to share several stories with you, stories that provide some interesting insights - -

LATER WE'LL TELL STORIES THAT APPLY THESE INSIGHTS

BIRD STORY

The first is a fascinating story I first heard in an anthropology class at Columbia >20 22 years ago - - this story helped me notice and think about such things - - This **sketch from Bonner's "Evolution of culture in Animals"** is a good icon for the story - -

In the late forties, some British bird watchers noticed members of a particular small species of bird opening milk bottles and drinking the cream - - this quaint phenomenon attracted curiosity - -others began to look for it - - at first it was confined to a small region, but then it suddenly spread out much like an epidemic - - spreading widely in just a few months - - diffusing eventually throughout the British Isles - - here's a **sketch suggesting the diffusion of that innovation** (talk about the sketch) - - birds have an instinct for context switching when they notice other birds feeding (pecking at something) - - they tend to observe and then imitate the feeding behavior - - in this case, once the innovation was made - - it went above threshold - - diffusion of the innovation - - each bird not aware of its role in the process - - but the overall group acquired a new behavior - - became a stable form - - IN WHAT DOES IT CONSIST? - it consists of its behavioral feasibility, observability, imitatibility, and the facts and measures of its behavioral production over space and time - -

(BACKUP)

(FORWARD

What might have gone differently? - - I wonder why it diffused faster in one direction than another - - what if the birds had a slightly lower feeding range - - how small a range before the propagation went below threshold? - - so that the innovation would have been lost - - could done here artif intro beh?

MONKEY STORY

That story was so noticeable, memorable and retellable that it propagated widely among human biologists, who then started noticing such innovations in other species - - some of the most interesting observations being made by Japanese biologists of innovations by wild macaques on a remote island - - this **photo of macaques washing food, from Beck's "Animal Tool Behavior"** is a good **icon** for this story - - the biologists placed sweet potatoes on the beaches to stabilize the macaques' food supply - - a young female innovated dipping them in water to wash off the sand - - other troop members observed and imitated this behavior, and it gradually diffused throughout the island's troop - - later, the biologists added wheat to the animals' diet, piling it on the beaches - - the same monkey genius (her name was Imo) while trying to "wash the wheat" discovered that dropping it on the water was a good way to separate it from sand - - and this complex innovation also diffused throughout the troop - -

These stories really intrigue me - - they build intuitions - - but also lead to further questions - - for example we might theorize that factors like noticeability, imitatibility, association with food or reward, frequency of occurrance, etc., mediate the diffusion process - - and, I wonder if Imo would have invented wheat placer mining, if she hadn't first invented potato washing? - -

AGRICULTURE STORY

What about more complicated situations? Do innovations propagate in a somewhat similar way in human groups? This topic is of considerable interest in anthropology - - some of the recent work is revealing - - this figure from Cavalli-Sforza's and Feldman's book on Cultural Transmission and Evolution - - showing the **diffusion across ancient Europe** of a complex of food-production innovations - - as early farming displaced the age-old hunter-collector methods - - quantitative models for such processes are being developed and tested - - and we can look forward to deeper insights in the future - -

You'll notice that this agriculture wave was relatively slow-paced- - moving about 1000 mi in 2000 yrs - - but it consisted of a large complex of innovations that had to drift together - - but it was inexorable once started - - among other things it enabled a greater population density than did food collection - - so large numbers of human culture-carriers kept filling-in behind the moving wave-front - - thus keeping up the pressure at the wave front - -

Once the food-production wave passed, other innovations swept very rapidly through its population - - for example, the use of copper spread much more rapidly than had the farming itself - - I wonder why? - - copper-use was a smaller innovation complex - - the new agricultural complex had a pretty dense population - - it also had pretty stable trading patterns - - maybe those helped copper-use spread so fast - -

"SEEING" THE INFRASTRUCTURE

- > What mediates the rate/extent/content of such changes?
- > Visualizing the underlying cultural infrastructure.
- > Dramatic effects of changes in infrastructure.
- > Stories providing insights and metaphors.

VISUALIZING AND MEASURING CHANGE

I wonder what determines how fast one set of innovations diffuses and displaces another? - - how can we **visualize what the structures and processes** are that mediate cultural change? There are some stories from history that I've found interesting that I'd like to share with you - - the interesting thing is how they help to reveal what the infrastructure is by showing the **dramatic effects when you change the infrastructure** - -

When we talk about change here - - **(show displacement slide)** - - whether it's food-production displacing food-collection - - or steam ships displacing sailing ships - - I'd like to think in terms of measurables like the number of people that do the thing - - i.e. are carriers of that form or members of that clan - - or else the number of artifacts of their behaviors - - or productions - - so for example in the figure - - -

HISTORY · WEBER · MOD. OF FRANCE

There's an interesting way of researching history - - pioneered by Braudel - - that focusses on a demographically weighted view of events. Instead of studying details of the fine structure at the top of civilizations, one studies the wide-spread deeply embedded structures of everyday life of the masses - - charting the changes in the patterns of everyday life - - It's amazing how stable these deep structures have been over recorded history - - shifting only slowly - - even as wars raged and empires rose and fell - -

That idea of cultural inertia somewhat marks that school of history - - and Braudel is fascinated with the question of "what are the limits of the possible?" - - seeing things as stabler and harder to change than most folks realize - -

But there's a work based on similar methods that documents something very different - - **(slide of Weber's book)** - - that's Weber's fascinating history of the dramatically rapid modernization of rural France over the short span of ~40 years - - this work contains many lessons - - I'll paraphrase one story from it to hint at its scope - -

The little rural village - - isolated clan of peasant farmers - - a unique local culture - - limited energy sources - - the practice in winter of all villagers huddling together in one house, then after a week or two, going on to the next - - this was their innovation to cope - - but it provided as a side effect a novel element of communications infrastructure - - it mediated the formation and propagation of their oral history - - providing stability for their clan - - stability from what little outside influence there was - - -

MODERNIZATION OF RURAL FRANCE

And then one year - - a roadway was suddenly cut through the woods right by the village - - strange people began passing by - - new forms of trading began - - economic efficiency increased - - the young travelled to distant villages - - the few villagers who became literate would read the others the letters they received - - and the stories about life in distant cities - - there wasn't a need to huddle in winter anymore - - so instead of just interacting intensely within their own clan - - each villager began gradually to interact with the outside world - - the local rural culture faded away - - and a new form appeared - -

The point of the story and the thing to visualize is that the same thing was going on simultaneously all over France - - railroads, carriage roadways, telegraph lines, a postal system, all going in at once - - and as this transportation and communication system was laid down, all the thousands of local peasant cultures drifted in form and converged on the new cultural forms that developed around and propagated through this spreading infrastructure - - forms often quite intentionally propagated from the civilized urban centers - - thus thousands of local folk innovations and practices disappeared - - but the door was open for extending the new innovation domain of that time - - industrialization - -

The industrial revolution produces similar rapid changes in many other countries - - as the new interconnected system of mines, smelters, foundries, mass production factories, railroad lines, and telegraph lines self-propagated everywhere - - attracting use through new efficiencies and opportunities - - enabling and propagating innovations on a time and distance scale never before possible - - and the form and parameters of the new transportation and communications systems largely determined the rate of the resulting cultural evolution, by resetting the limits of the possible at the time.

Q

These perspectives from the past make me wonder - - isn't information technology playing a similar role in our time? - - could a very similar process now be underway? - - because it seems like the central position of the now-stable industrial infrastructure - - is being displaced by the new information infrastructure - - This seems to be happening all around us - - we can notice it through our mass media - - but without perspectives from the past we might not sense the profound possibilities for what's ahead - -

PRESENT

A recent National Geographic had a long picture-story about chips, the valley, and various aspects of computing - - a couple of the pictures in it struck me as touching reflections of what seems to be happening out there - - in it we see the **now familiar child at play** - - intensely involved in **interactions with a computer game** - - playing - - becoming a person in the world ahead - - and we see a **picture of a Nebraska farm family** - - which reminds me of the earlier story about France - - and I can now visualize that here in our time - - people all over the place are suddenly finding new ways to intermediate their interactions - - new ways to plan and conduct their lives - - through the machines and networks and software that we're creating - -

DESIGNING NEW INFRASTRUCTURE

- **Intellectual agents of change in the practical world.**
- **Brainstorming about methods and heuristics.**
- **Joint evolution of infrastructure and its usages.**
- **Stories of experiences.**

AGENTS

as electrical engineers

So, folks, ~~whether we like it or not~~, we're **agents of change in the world** - - that's what we do - - our technology has already had a huge effect on the world - - but think for moment - - if we can continue applying any past innovations to help produce AND propagate future innovations, then we've really got leverage - - what we've seen so far is just the beginning - -

A STORY FROM MY EXPERIENCE

In my group's own research work, we've brainstormed quite a bit about how to find stronger methods and how to use our technology for innovating and propagating ideas - - I'd like to sketch some of our experiences - - to show how we've applied insights we gained from things like the biology, anthropology, and history stories - - I'm sure we've just scratched the surface - - and that there's lot more to discover in this area - -

Many of you are familiar with the Mead-Conway VLSI design methods - - I'll now briefly tell some of the story behind the design and propagation of those methods - - (here's an icon for the story) - - **(show slide of book)** - - there are a number of lessons to look for in the story - - many are straightforward - - it takes innovation to make complicated things simple but once that's done, it's easier for folks to get into simple things, so they propagate more easily - - things are more likely to propagate if they are noticeable - - if they look like they might be FUN - - if doing them proves to be FUN - - and if they provide artifacts you can use to amaze your friends - - the story also reveals some of the more subtle and complex methods - - (i) for the **joint evolution of a new piece of technology along with its uses** - - and (ii) for using the computer-communications environment to help in the process - - and the main lesson is that a small group of folks may be able to cause large effects in a short time if they use strong methods - -

MIT COURSE

In the mid-70's I and my group at Xerox began collaborating with Carver Mead and his group at Caltech in an effort to create improved VLSI design methods - - so that system designers could create systems in silicon as easily as in TTL- - we had some successes in this early work, so we began to document the new methods and create examples of their usage - -

In '78, I travelled to MIT, to teach an experimental course to further test the ideas and to test a preliminary text on the material - - in a one semester course student learned the basics of design, and then did design projects - - here are some slides suggesting the sort of thing they did - - **MIT student project slides** - - the projects were extremely exciting to do - -

MIT COURSE

Following the course we transmitted the design files over the ARPAnet to the west coast - - merged them into one giant multiproject chip type - - and fabricated the chips - - here's **a slide sketching that process**, and a **map** and a **photo** of a resulting multiproject chip - - notice that such chips and photos make amazing, noticeable artifacts - -

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A number of the projects worked - - and it looked like we really had something here - - the MIT course had produced a noticeable result - - as the next school year approached, we completed work on the book about the methods - - and I wondered what to do next - -

WHAT NEXT?

I'd already gotten some leverage by using the ARPAnet - - **(show map of net)** - - and I thought what if we fond a way to provide fast implementation of chips for a whole bunch of universities? - - that might attract a lot more folks to try the methods - - and further test and propagate them - - the idea of an automated server, interfacing the net - - simple to interact wtith - - to handle lots of electronic mail interactions and design file transfers from remote users - - **(show remote MPC sequence)** - -

MPC79

So in the summer of '79 we began work on the server software and announced out over the net that if folks would send us their design files by a certain date at the end of the courses, we would implement their chips for them - - we got a HUGE response - - folks who had noticed the MIT course - - we then provided instructional materials, ran some instructors' courses, and provided detailed instructional msgs, library cells, etc., over the net to help initiate and coordinate the project activities, so they could imitate the MIT type of course - -

Alan Bell pioneered the architecture and design of the **implementation system** (slide) that we'd used to interact with users by msgs - - to build up the data-base of design files - - and then after the design deadline to merge them into a group of multiproject chip files, and convert those files for maskmaking - -

Courses ran at a dozen universities that fall, with a lot of competition and collaboration going on - - tremendous excitement was generated - - there was a great rush of activity all round the country as the Dec. 4 deadline approached - - and then the deadline passed, and here's **Alan Bell merging the resulting projects** - -

The masks were then made, wafers fabricated, and the resulting project chips all wire-bonded and packaged - - there were 82 projcts in all from 124 designers - - these slides suggest the scale of the adventure **(MPC info** and **artifact slides)** - - and four weeks after the deadline, all the students got back their packaged chips - - a vast collection of artifacts now went into circulation - - and what FUN it was for everyone! - -

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There were many stunning results - - including some full-die-sized designs such as **this LISP microprocessor** by researchers at MIT's artificial intelligence lab, and many many innovative design prototypes - - for example the first prototype for Jim Clark's VLSI geometry engine was implemented in this **MPC from Stanford University** - - it's in the lower right corner - - and as many of you know, Jim's architectural innovations in that work have been the basis for an exciting new venture startup - Silicon Graphics, Inc. - - a venture that will seize the commercial opportunities opened up by that work - -

The large-scale and the success of this multi-univ effort helped us more completely debug the design methods - - debugged many of the associated new design tools - - but perhaps most important, the result went significantly above threshold - - in terms of artifact production, tool distribution, and provision of widely known-about scripts for all the various parts of the action, etc. - - so it embedded the overall phenomena into the technical culture - - we followed this process in some detail as it was occuring - - for example tracking the **diffusion of design tools and design environments** as suggested in this slide - - to get some sense of its structure, and to tune our methods - -

(- - if time talk status - - >120 univ. - - lots of ind. - - start-ups - - MOSIS - -)

Now let's reflect a bit on the methods that were used - - first there was the basic method of **experimental computer science** - - **generate and test** - - this was reapplied during each of the **successive stages in the evolution** of the various systems being generated - - finally, notice there was a **cluster of systems being jointly evolved**, including the design methods, instructional materials, courses, design tools, implementation methods, and finally the design projects themselves - - Now, I think you can see how the implementation of the design projects closed all the experimental loops in this effort - - and how our computing and network facilities, and our implementation service provided powerful infrastructure for the rapid scaling up of the entire evolutionary enterprise - - we LEVERAGED existing information infrastructure to create new pieces of infrastructure - - we used technology to create an environment for rapid accumulation and propagation of innovations by a large, dispersed research community.

I hope that sharing and studying stories like this, maybe we can further improve our methods - - **so that as this slide suggests** our methods can make a real difference in whether our innovations take hold - - (describe) - - but remember that WE are most often designing new infrastructure - - and whether its hardware, networks, environments, or applications - - we create technology other people must acclimate to, adapt to, technology that changes the way they work or play - - but such things are like a road - - and for a road to be a road it must have users, must be in folks minds, be on the maps, have maintainers - - (finish road concept) - - so creating a road means creating those things too - -

WHAT ARE THE LIMITS TO WHAT WE CAN CREATE?

- > **Resetting the limits of the possible.**
- > **Constraints on the rate/extent/content of change.**
- > **Open possibilities for quantitative and qualitative change.**
- > **Example of a new initiative.**

> RATES

As a final topic, let's speculate a bit about the future - -

Given the successes of computing field so far, we might wonder: **what are the limits** to what we can create? As innovations accumulate, we keep **resetting the limits of what's possible**, in terms of how fast and to what extent we can propagate our innovations - - sure, cultural intertia **still constrains those processes** - - but the inertia keeps declining as new technology appears that makes it easier for people - - increasingly independently of location - - to notice, observe, interact, imitate, play, compete, collaborate, and become skilled in doing new things - -

KEY IDEA:

Forgetting rates of change for a moment, what about the content of the coming changes? - - ah, there are so many **open possibilities** for innovations to expand our information infrastructure - - I'd like to sketch just two technological areas - - two kinds of things that are just about ready to propagate - - I think they're different enough to suggest the amazing space of possibilities - - (Also, you might think how you would use existing technology to hasten innovation and propagation in these areas, applying what we've learned so far)

SURROGATE TRAVEL

The first is aimed at enhancing human visual, tactile, experiental interactions with remote phenomena - - it's something that many of you have already noticed or are involved in - - and that's the amazing things coming from the convergence of television and videodisc technology with computing technology - - interactive computing and the powerful new graphics image-generators merged with interactive real-world-like visual television imagery - - this promises to open up a whole new dimension for human experiences - - there was a wonderful demo of the work of the Architecture Machine group at MIT that was propagated around on national TV - - the demo provides a metaphor and a propagation method for the technology - - tell the "story about riding around Aspen" - - (- - SLIDES - -) - - but think what might come next - - riding your exercise machine around Aspen - - encountering others as generated images - - in a giant network game - - now that stuff will be great fun to use - - and so many folks will likely encounter it and learn to use it in games - - but it will be wonderful information infrastructure to use to explore and interact with the world - -

aka. "SURROGATE TRAVEL"

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XS

Another interesting technology on the horizon is aimed at creating remote servers that mimic practical human reasoning - - the practical application of AI methods in expert systems - - instead of bringing the world to you like the interactive video stuff - - it's the reverse of that - - it's about how to plant some of your intelligence in servers in the network - -

PARC KSA XS

Some of the possibilities are suggested by the story of research work that Mark Stefik, Danny Bobrow, and Sanjay Mittal have underway in my group at PARC - - - They're trying to simplify and propagate the technology for building expert systems - - it's a technology that's presently in an arcane form - - it's difficult to get into, and has only a modest following in AI circles - - now, how should we proceed? - -

In the first move towards simplification, the group created a software environment on top of interlisp called LOOPS - - **(show the LOOPS logo)** - - this enviroment integrates together simple, easy to learn versions of the major programming paradigms including object-oriented, data-oriented, and rule-oriented programming methods, needed for knowledge representation in expert systems - - we believe that LOOPS provides an easy environment in which to build expert systems, and one that can be evolved towards eventual use by non-AI specialists - -

LOOPS

Following a now familiar pattern - - the group is trying to use information technology to boost the process of simplification and propagation - - trying again for the kind of technology leverage we got in the MPC adventures - - we've begun offering intensive courses where folks study the LOOPS environment and then build a modest rule-based system, all in three days - - students get started easily by modifying an existing mini-expert system that deals with familiar real-world practical knowledge in a simulation/game world - - and they're motivated by the challenge and the fun of having to face a competition on the last day of the course - - The "knowledge competition" is a playoff among the mini-expert systems that participants build during the final 2 days of the course - -

KNOWLEDGE COMPET.

This slide shows plots of **some of the icons and artifacts** of the simulation/game world - - Each expert system controls the movement, and the buying and selling of commodities, by an "independent trucker" in a simulation world. The simulation is animated like a video game, with the trucks all running back and forth, buying and selling goods, stopping for fuel, and trying to avoid hijackers. But unlike a video game where you grab the controls ourselves, here our expert system plays the game for you - -

This **slide shows a detailed roadmap of the truckin world** - - it includes data driven guages to monitor your status - - here're some inheritance lattices for that world's objects, **commodities to buy and sell,** and **hazards to deal with** - - and here's **an expert system builder deep in thought**, creating his game player - - and finally here's a snaphot of a class watching their **players compete against each other in the playoffs** - -

XS EFFECTS --- THE METAPHOR

CONVERGENCE

Besides providing a teaching environment, we're hoping that the game is an easy-to-remember/easy-to-tell story that stands as a metaphor for the key idea - - that expert systems can positioned as intelligent agents and servers in machines out in the network, doing your bidding for you, they can explain why they just did something - - explain it in terms of practical reasoning, and if they goof-up, or if the world changes in some way they can't cope with - - then they can be easily modified at the level of practical knowledge - - all sorts of possible side effects - - a more commonly shared literacy re practical knowledge - - scaling effects - -

but now

Ah, and think of the possibilities for convergence with the technology of the other example! the generated images might be another player in the network - - but now the player might be an expert system! - -

THE OPEN FRONTIER

These two examples suggest the many dimensions along which we might leverage our technology to further augment our information infrastructure. In the process, we'll undoubtedly open up new forms of human experience, and new directions for cultural change. Who can say where this frontier will end - - who knows what the limits might be - - to what we can eventually create - -

CONCLUSION

- > Intellectual leverage as a unifying theme.
- > Gaining a sense of our role in events.
- > Anticipation and excitement about the future.
- > Metaphors and stories to propagate the ideas.

To conclude - -

By exploring the sources and the effects of intellectual leverage, we can **gain both a greater role in events**, and a greater **understanding OF our role in events**, a role of far more influence than is at first obvious - -

working in infor. tech

We can also gain a better appreciation of how fortunate we are to be in ~~this field~~ at this time - - and a sense of **anticipation and excitement about the future** - -

I hope my **stories** will lead you to see familiar things from new perspectives - - and help to propagate those new perspectives - - so that when we observe a seemingly simple natural event like a **bird opening a milk bottle**, maybe we'll wonder where in the world that innovation came from - - whether it's spreading or not - - and what things are influencing the diffusion process - -

And when we **observe a person using a powerful personal computer** interfaced to a large network - - instead of seeing a reclusive hacker running an arcane program - - maybe we'll wonder if this might be a creative individual using strong methods of leveraging technology to participate in, or even lead, some great adventure out in the networks!

Thank you!

SHORT Q/A ---

NOTE - THERE BE ADDED CHANCE TO FIELD QUESTIONS ---
AND INTERACT -- ON WEDNESDAY ILL GIVE
A SHORT TUTORIAL ON EXTENSIONS OF THE
NETWORK/IMPLEM. SERVICES TO FURTHER AID IN SYST. PROTOTYP.

PROVIDE A CHANCE TO BRAINSTORM --- APPLY IDEAS DEV. HERE
TO SPECIFIC NEW PROBLEMS ---