

Neurocomputing

A Large-Scale Non-Traditional Application

Robert Hecht-Nielsen

Computational Neurobiology

University of California, San Diego



HPC WPL

Sandia Labs

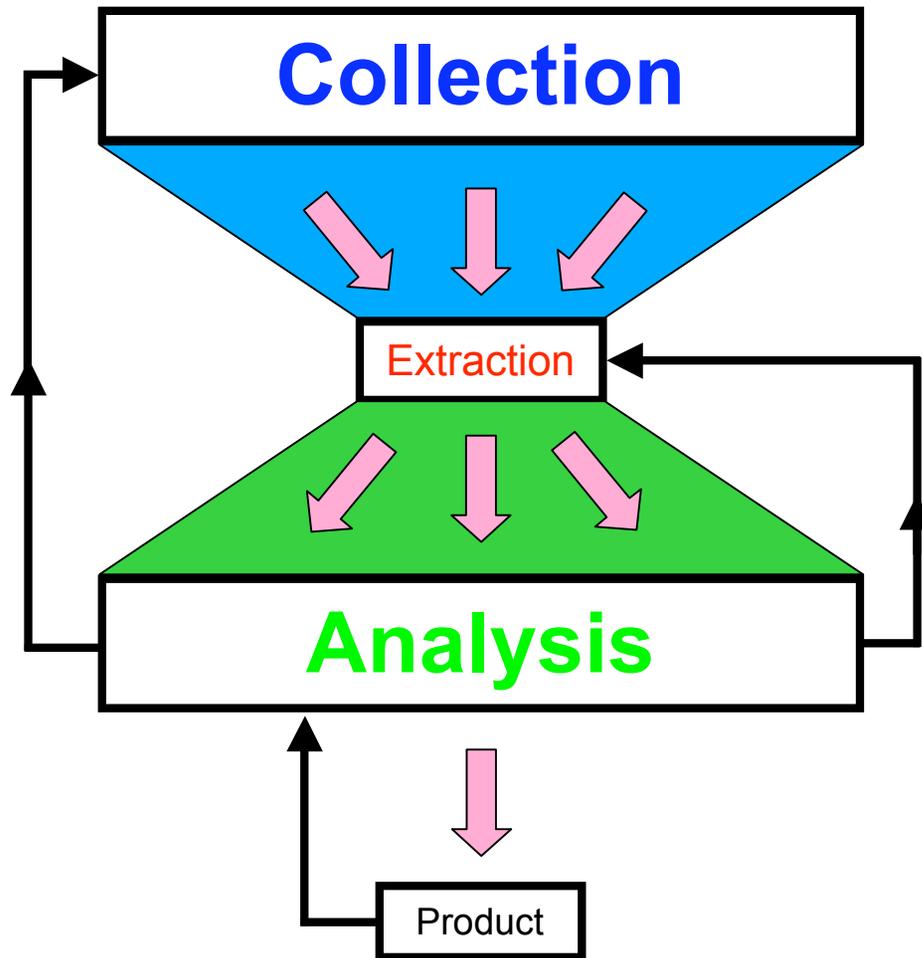
Albuquerque, NM

Tuesday 12 December 2006

Agenda

- **Architecture of the Intelligence World**
- **Extraction Requirements**
- **Extraction Systems Organization Characteristics**
- **DOE Extraction Systems Organization**
- **Technical Approach**

Architecture of the Intelligence World



Extraction Requirements

- Deal with SIGINT, IMINT, ELINT, CHEMINT, etc. inputs
- Near 100% detection and extraction of desired data
- Near 0% detection and extraction of unwanted junk
- Near real-time extraction
- Data delivered with pedigree & explanation (audit trail)
- Each individual analyst can task extractor system
- Extractor establishes and expands its 'ongoing personal working relationship' with each individual analyst

Extraction System Organization Requirements

- **Extremely high security** (high volume, deep interaction required with both Collection and Analysis organizations)
- **Turnkey provision** of a bulletproof extraction system that works 24/7/365, as well as user training
- Periodic phased switchover of Intelligence Community to next extraction system version (approx 5 year cycle)
- Development and upgrading process is institutionalized, just as in the auto industry
- Collectors and Analysts **have no need to know** how extraction system works (this knowledge should be **highly restricted**) – users need only know extraction system's capabilities and how to use it

DOE ESO

6

- **Established in 2008 by Executive Order (Divisions: Current System, Next System, Next² System, Support)**
- **Located in buried, highly protected, dedicated facilities at existing DOE / DOD sites (Sandia, Los Alamos, etc.)**
- **Each new generation of extraction system is housed in its own dedicated facilities dispersed around the US**
- **Decommissioned previous-generation extraction facilities are completely destroyed for security**
- **Extraction system components interact with collection and analyst elements, and with each other, via secure redundant datalinks**
- **ESO budget \approx ramping up to \$300B / year (2006 dollars)**

DOE ESO Scope (2015)

- **300,000 ESO employees**
- **100,000 Contractor employees**
- **Hundreds of separate facilities**
- **Annual performance evaluation by Intelligence Director**
- **ESO Security Service**
- **ESO Inspector General**
- **ESO role quickly becomes institutionalized**

Confabulation Theory in a Nutshell

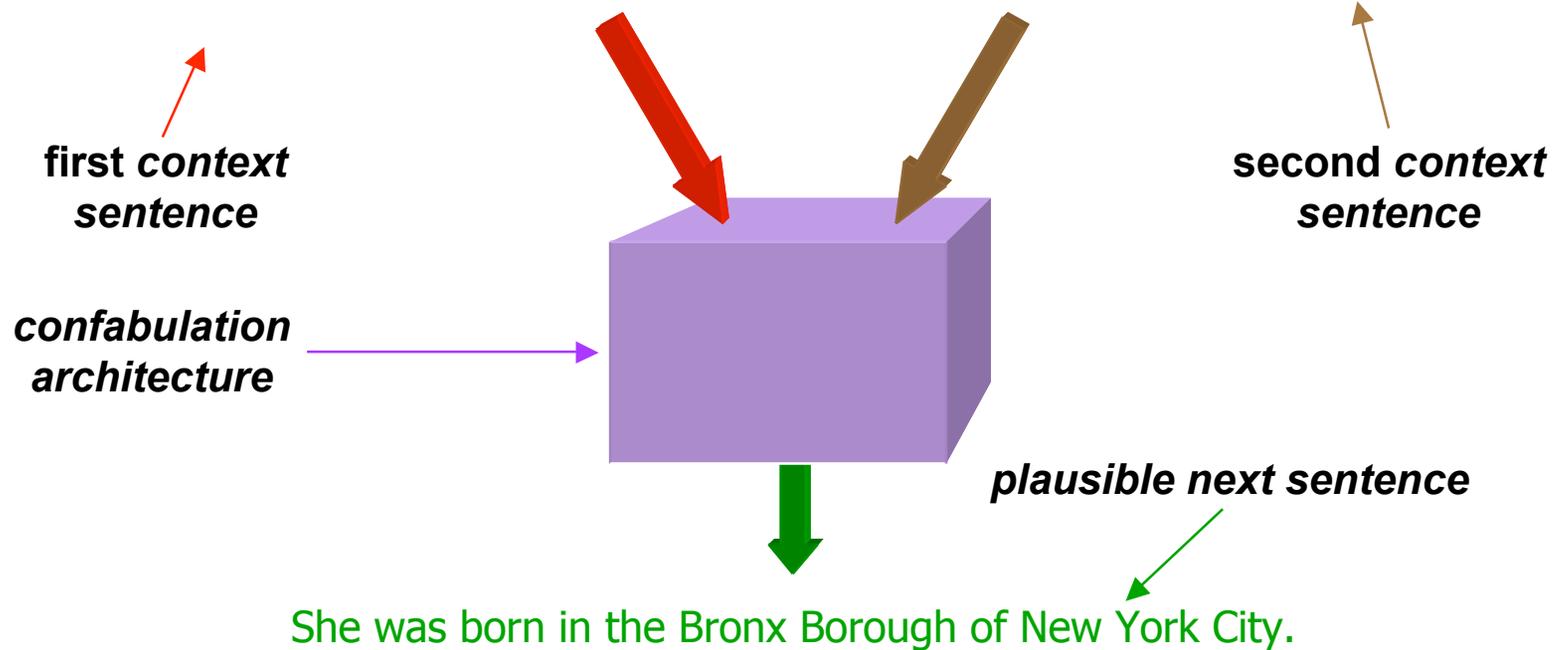
Thinking is a phylogenetic outgrowth of movement. Multicellular animals began moving about a billion years ago. The fitness benefits of purposeful, flexible, and adaptable movement rapidly drove the development of nervous systems. Soon, a new design possibility emerged: the elaborate neuronal machinery already developed for controlling movement could be applied to brain tissue itself. In particular, discrete brain structures, *modules*, emerged that could be controlled exactly like individual muscles. By manipulating these modules in properly coordinated 'movements' (*thought processes*), information processing (*cognition* – vision, hearing, planning, reasoning, language, movement and thought process selection and inauguration, etc.) could be carried out – thereby further enhancing animal competitive success and diversity. The purpose of each module is to describe one *attribute* that an object of the mental universe may possess. This description takes the form of activating one of a large number of *symbols* (each a small collection of specialized neurons) within the module. An individual axonal *knowledge link* (of which the average human adult possesses billions) will unidirectionally connect a *source symbol* in one module with a second meaningfully co-occurring *target symbol* in a second module (*a la* Hebb). A module receiving knowledge links from symbols on other modules can be commanded to 'contract' (*confabulate*) – yielding a single active *conclusion* symbol; namely, the symbol having the highest level of summed incoming knowledge link excitations. Mathematically, confabulation maximizes *cogency* (the conclusion selected is that which is most supportive of the truth value of the symbols supplying input excitation); the generalization of Aristotelian logic upon which all animal cognition is based. *Multiconfabulation*, in which multiple modules gradually confabulate, while mutually communicating via knowledge links, allows the parallel application of vast numbers of relevant knowledge links. Every time a module reaches a conclusion, *action commands* axonally connected from that conclusion (these learned connections are termed *skill knowledge*) are instantly launched. Action commands cause all non-reflexive and non-autonomic *behavior* (movement processes and thought processes). The extreme power of thought derives mostly from these last three factors: the massive parallel application of knowledge, the interoperability of knowledge links across attributes, and the context-sensitive triggering of new behaviors many times per second. © 2006, Robert Hecht-Nielsen, All Rights Reserved.

A Confabulation Architecture

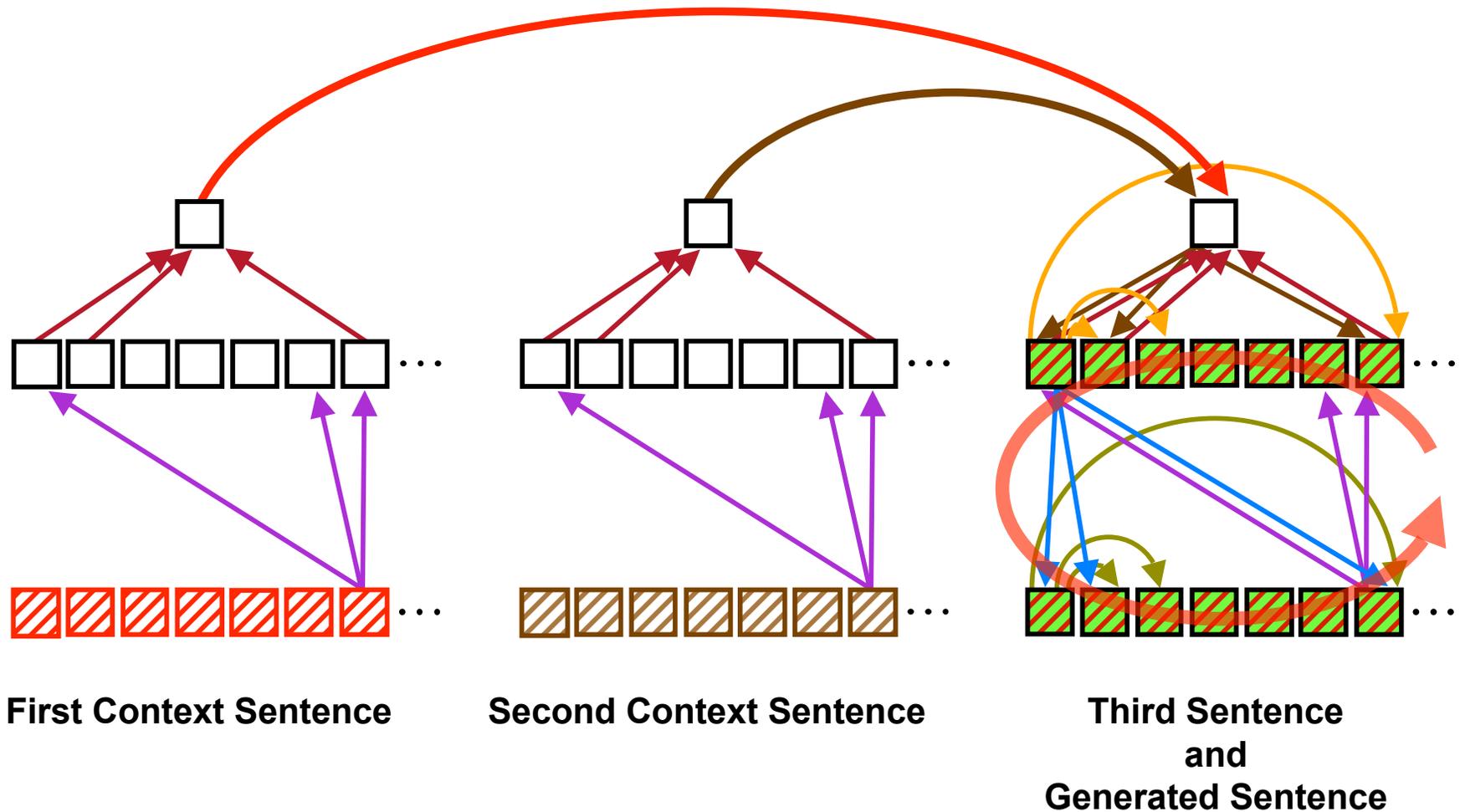
Sentence Generation System: Add a *Plausible Next Sentence* to two previous *Context Sentences*

Several other centenarians at Maria Manor had talked about trying to live until 2000, but only Wegner made it.

Her niece said that Wegner had always been a character – former glove model , buyer for Macy's, owner of Lydia's Smart Gifts downtown during the 1950s and '60s – and that she was determined to see 2000 .



Plausible Next Sentence Generation Architecture 10



Sentence Generation System Results

11

A total of 22 defendants were convicted after the five-month trial of possessing explosives and plotting terrorist acts, but all were acquitted on charges that they were linked to the Al Qaeda terrorist network.

Jordanian authorities now have a second chance on the Hijazi case.

The defendants are accused of conspiring with the outlawed rebel group.

The doctrine is frank about Russia's economic weaknesses, calling for efforts to strengthen the economy in order for the country to remain a major power.

It acknowledges that it is in Russia's interest to maintain its economic links to the outside world and there is no suggestion that it intends to abandon free market principles.

President Boris Yeltsin has expressed his willingness to compromise.

Investigators say one man who got his license through a fixed test was Ricardo Guzman, the driver of a truck involved in a 1994 wreck in Wisconsin that killed six children in a burning minivan.

Prosecutors say Bauer, now retired, hastily shut down the probe of the accident and blocked other investigations that might have embarrassed Ryan.

The driver fled the scene after the collision.

Sentence Generation System Results

The shortage has been attributed to rapid expansion of the prison system, low pay, a booming economy that makes the prospect of spending the day guarding convicts less attractive, and the risks of dealing with inmates who seem to be getting meaner and more violent.

Prison officials are scrambling to keep penitentiaries staffed, recruiting at schools and from the Internet.

Prison officials are still debating what they have to do.

Outside investigators announced the conclusions Tuesday as NASA's top scientist confirmed that the agency will cancel plans to launch a robot spacecraft in 2001 on a mission to land on Mars and indefinitely postpone all future launches to Mars, with one exception: a 2001 mission.

With only its aging Mars Global Surveyor in orbit around Mars, the agency is reassessing its entire approach to the exploration of the planet after losing all four of its spacecraft bound for Mars last year – a package totaling \$360 million.

Mars Global Surveyor will be mapping out the planet.

Michelle strengthened from a Category 2 to a Category 4 storm Saturday, with winds reaching 140 mph, but it was expected to weaken before it reached Florida.

The storm or its effects could strike the Keys and South Florida tonight or early Monday, said Krissy Williams, a meteorologist at the National Hurricane Center in Miami.

Forecasters warned residents to evacuate their homes as a precaution.

Sentence Generation System Results

13

Seeing us in a desperate situation, the Lahore airport authorities switched on the runway lights and allowed us to land with barely one to two minutes of fuel left in the aircraft, he said.

At Lahore, Pakistani authorities denied Saran's request to accept wounded passengers and women and children, but they refueled the plane.

Airport authorities said they were not consulted beforehand.

People protesting the INS decision gathered today in front of the agency's offices in Miami and the home of relatives who have cared for the boy since he was rescued on Thanksgiving Day .

The boy was found clinging to an inner tube at sea after his mother and nine others died when their boat sank during their effort to leave Cuba for Florida.

Elian's mother and her grandparents perished in concentration camps.

But the constant air and artillery attacks that precede the advance of Russian troops have left civilians trapped in southern mountain villages, afraid to venture under the bombs and shells raining on the roads, Chechen officials and civilians said.

Residents of the capital Grozny who had fled the city in hopes of escaping to Georgia, which borders Chechnya to the south, have been stuck in the villages of Itum-Kale, 50 miles south of Grozny, and Shatoi, 35 miles south of Grozny.

Russian forces pounded the strongholds in the breakaway republic.

Sentence Generation System Results

14

Both Michael Skakel, and his older brother Thomas, then 17, were looked at possible suspects, along with others, including a tutor who had just moved into the Skakel house the day of the killing.

After more than two decades of dead ends, Thim was appointed as a grand juror in June 1998.

Prosecutors said they were not adequately informed of the probe.

The doctrine is frank about Russia's economic weaknesses, calling for efforts to strengthen the economy in order for the country to remain a major power.

It acknowledges that it is in Russia's interest to maintain its economic links to the outside world and there is no suggestion that it intends to abandon free market principles.

President Boris Yeltsin has expressed his willingness to compromise.

Investigators say one man who got his license through a fixed test was Ricardo Guzman, the driver of a truck involved in a 1994 wreck in Wisconsin that killed six children in a burning minivan.

Prosecutors say Bauer, now retired, hastily shut down the probe of the accident and blocked other investigations that might have embarrassed Ryan.

The driver fled the scene after the collision.

Sentence Generation System Results

15

The National Corn Growers Association says Gore is likely to have an ear of corn following him too if EPA sides with California officials, who oppose using ethanol.

Ten days before the Iowa caucuses, Gore was more than 20 points ahead of Bradley in various Iowa presidential polls.

Gore's aides said they would not have any problems.

The incident threatens relations between the Americans and Kosovo civilians, whom the peacekeepers were sent to protect after the 78-day NATO bombing campaign.

We don't want them here to give us security if they are going to do this, said Muharram Samakova, a neighbor of the girl's family.

NATO has struck a military airfield near Pale.

Now, I must admit that I'm not so sure the Palestinians really wanted to reach a framework agreement, Eran said Tuesday.

Eran wondered aloud whether the Palestinian strategy might be to negotiate as much land as possible in the remaining transfers, then declare statehood unilaterally – as the Palestinians have threatened to do before when talks bog down.

Netanyahu said the Palestinians would be barred from jobs in Israel.

References

1. Hecht-Nielsen, R. (2005). Cogent confabulation. *Neural Networks*, 18, 111–115.
2. Hecht-Nielsen, R. (2006) Mechanization of Cognition. In Y. Bar-Cohen [Ed.], *Biomimetics* (pp. 57–128). Boca Raton, FL: CRC Press.
3. Hecht-Nielsen, R. (2006) The mathematics of thought., in: Yen GY, Fogel DB (eds) *Computational intelligence*. IEEE Computational Intelligence Society, Piscataway, NJ, pp 1–16.
4. Hecht-Nielsen, R. (2006) The mechanism of thought., in: *Proceedings of the World Congress on Computational Intelligence*. Vancouver, BC, Canada. July 16–21, IEEE Press, Piscataway, NJ.
5. B. Sagi, S.C. Nemat-Nasser, R. Kerr, R. Hayek, C. Downing and R. Hecht-Nielsen. 2001. A biologically motivated solution to the cocktail party problem. *Neural Computation*, July, 13 (7), 1575-1602.