1. **INTRODUCTION OF BLUE BRAIN**

Human brain is the most valuable creation of God. The man is called intelligent because of the brain. The brain translates the information delivered by the impulses ,which then enables the person to react. But we loss the knowledge of a brain when the body is destroyed after the death of man. That knowledge might have been used for the development of the human society. What happen if we create a brain and up load the contents of natural brain into it?

The name of the world’s ﬁrst virtual brain. That means a machine that can function as human brain. Today scientists are in research to create an artiﬁcial brain that can think , response, take decision, and keep anything in memory. The main aim is to upload human brain into machine. So that man can think, take decision without any effort. After the death of the body, the virtual brain will act as the man .So, even after the death of a person we will not loose the knowledge, intelligence, personalities , feelings and memories of that man that can be used for the development of the human society. No one has ever understood the complexity of human brain. It is complex than any circuitry in the world.

So, question may arise “Is it really possible to create a human brain?” The answer is “Yes”. Because whatever man has created today always she has followed the nature. When man does not have a device called computer, it was a big question for all. Technology is growing faster than everything. IBM is now in research to create a virtual brain, called “Blue brain”. If possible, this would be the ﬁrst virtual brain of the world. With in 30 years, we will be able to scan ourselves into the computers. Is this the beginning of eternal life?

**2. WHAT IS VIRTUAL BRAIN?**

Virtual brain is an artiﬁcial brain, which does not actually the natural brain, but can act as the brain. It can think like brain, take decisions based on the past experience, and response as the natural brain can. It is possible by using a super computer, with a huge amount of storage capacity, processing power and an interface between the human brain and this artiﬁcial one. Through this interface the data stored in the natural brain can be up loaded into the computer. So the brain and the knowledge, intelligence of anyone can be kept and used for ever, even after the death of the person.

**Why we need Virtual Brain?**

Today we are developed because of our intelligence. Intelligence is the in born quality that cannot be created. Some people have this quality, so that they can think up to such an extent where other cannot reach. Human society is always need of such intelligence and such an intelligent brain to have with. But the intelligence is lost along with the body after the death. The virtual brain is a solution to it. The brain and intelligence will alive even after the death. We often face difﬁculties in remembering things such as people’s names, their birthdays, and the spellings of words, proper grammar, important dates, history, facts etc... In the busy life every one want to be relaxed. Can’t we use any machine to assist for all these? Virtual brain may be the solution to it. What if we upload ourselves into computer, we were simply aware of a computer, or may be, what if we lived in a computer as a program?

**How it is possible?**

They will be able to provide an interface with computers that is as close as our mind can be while we still reside in our biological form. Nanobots could also carefully scan the structure of our brain, providing a complete readout of the connections between each neuron. They would also record the current state of the brain. This information, when entered into a computer, could then continue to function as us. All that is required is a computer with large enough storage space and processing power. Is the pattern and state of neuron connections in our brain truly all that makes up our conscious selves? Many people believe ﬁrmly those we posses a soul, while some very technical people believe that quantum forces contribute to our awareness. But we have to now think technically. Note, however, that we need not know how the brain actually functions ,to transfer it to a computer. We need only know the media and contents.

**3. WORKING OF NATURAL BRAIN**

**Getting to know more about Human Brain**

The brain essentially serves as the body’s information processing centre. It receives signals from sensory neurons (nerve cell bodies and their axons and dendrites) in the central and peripheral nervous systems, and in response it generates and sends new signals that instruct the corresponding parts of the body to move or react in some way. It also integrates signals received from the body with signals from adjacent areas of the brain, giving rise to perception and consciousness. The brain weighs about 1,500grams (3 pounds) and constitutes about 2 percent of total body weight. It consists of three major divisions;

1. The massive paired hemispheres of the cerebrum
2. The brainstem, consisting of the thalamus, hypothalamus, epithalamus, subtha-lamus, midbrain, pons, and medulla oblongata
3. The cerebellum.

The human ability to feel, interpret and even see is controlled, in computer like calculations, by the magical nervous system .To understand this system, one has to know the three simple functions that it puts into action; sensory input, integration &motor output.

**Sensory Input**

When our eyes see something or our hands touch a warm surface, the sensory cells, also known as Neurons, send a message straight to your brain. This action of getting information from your surrounding environment is called sensory input because we are putting things in your brain by way of your senses.

**Integration**

Integration is best known as the interpretation of things we have felt, tasted, and touched with our sensory cells, also known as neurons, into responses that the body recognizes. This process is all accomplished in the brain where many, many neurons work together to understand the environment.

**Motor Output**

Once our brain has interpreted all that we have learned, either by touching ,tasting, or using any other sense, then our brain sends a message through neurons to effecter cells, muscle or gland cells, which actually work to perform our requests and act upon our environment.

**4**. **GOALS & OBJECTIVES**

The Blue Brain Project is the ﬁrst comprehensive attempt to reverse-engineer the mammalian brain, in order to understand brain function and dysfunction through detailed simulations. The mission in undertaking The Blue Brain Project is to gather all existing knowledge of the brain, accelerate the global research effort of reverse engineering the structure and function of the components of the brain, and to build a complete theoretical framework that can orchestrate the reconstruction of the brain of mammals and man from the genetic to the whole brain levels, into computer models for simulation, visualization and automatic knowledge archiving by 2015. Biologically accurate computer models of mammalian and human brains could provide a new foundation for understanding functions and malfunctions of the brain and for a new generation of information-based, customized medicine.

**5. Architecture of Blue Gene**

Blue Gene/L is built using system-on-a-chip technology in which all functions of a node (except for main memory) are integrated onto a single application-speciﬁc integrated circuit (ASIC). This ASIC includes 2 PowerPC 440 cores running at 700MHz. Associated with each core is a 64-bit “double” ﬂoating point unit (FPU) that can operate in single instruction, multiple data (SIMD) mode. Each (single) FPU can execute up to 2 “multiply-adds” per cycle, which means that the peak performance of the chip is 8 ﬂoating point operations per cycle (4 under normal conditions, with no use of SIMD mode). This leads to a peak performance of 5.6 billion ﬂoating point operations per second (giga FLOPS or GFLOPS) per chip or node, or 2.8 GFLOPS in non- SIMD mode. The two CPUs (central processing units) can be used in “co-processor” mode (resulting in one CPU and 512 MB RAM (random access memory)for computation, the other CPU being used for processing the I/O (input/output) of the main CPU) or in “virtual node” mode (in which both CPUs with 256 MB each are used for computation). So, the aggregate performance of a processor card in virtual node mode is: 2 x node = 2 x 2.8 GFLOPS = 5.6 GFLOPS, and its peak performance(optimal use of double FPU) is: 2 x 5.6 GFLOPS = 11.2 GFLOPS. A rack (1,024 nodes= 2,048 CPUs) therefore has 2.8 tera FLOPS or TFLOPS, and a peak of 5.6 TFLOPS .The Blue Brain Projects Blue Gene is a 4-rack system that has 4,096 nodes, equal to8,192 CPUs, with a peak performance of 22.4 TFLOPS. A 64-rack machine should provide 180 TFLOPS, or 360 TFLOPS at peak performance.

**Simulating the Microcircuit**

Once the microcircuit is built, the exciting work of making the circuit function can begin. All the 8192 processors of the Blue Gene are pressed into service, in a massively parallel computation solving the complex mathematical equations that govern the electrical activity in each neuron when a stimulus is applied. As the electrical impulse travels from neuron to neuron, the results are communicated via inter-processor communication (MPI). Currently, the time required to simulate the circuit is about two orders of magnitude larger than the actual biological time simulated .The Blue Brain team is working to streamline the computation so that the circuit can function in real time - meaning that 1 second of activity can be modeled in one second.

**Interpreting the Results**

Running the Blue Brain simulation generates huge amounts of data. Analyses of individual neurons must be repeated thousands of times. And analyses dealing with the network activity must deal with data that easily reaches hundreds of gigabytes per second of simulation. Using massively parallel computers the data can be analyzed where it is created (server-side analysis for experimental data, online analysis during simulation).Given the geometric complexity of the column, a visual exploration of the circuit is an important part of the analysis. Mapping the simulation data onto the morphology is invaluable for an immediate veriﬁcation of single cell activity as well as network phenomena. Architects at EPFL have worked with the Blue Brain developers to design a visualization interface that translates the Blue Gene data into a 3Dvisual representation of the column. A different supercomputer is used for this computationally intensive task. The visualization of the neurons’ shapes is a challenging task given the fact that a column of 10,000 neurons rendered in high quality mesh accounts for essentially 1 billion triangles for which about 100GB of management data is required.  Simulation data with a  resolution of electrical compartments for each neuron accounts for another 150GB. As the electrical impulse travels through the column, neurons light up and change color as they become electrically active. A visual interface makes it possible to quickly identify areas of interest that can then be studied more extensively using further simulations. A visual representation can also be used to compare the simulation results with experiments that show electrical activity in the brain .

**Data Manipulation Cascade**

Building the Blue Column requires a series of data manipulations .The ﬁrst step is to parse each three-dimensional morphology and correct errors due to the invitro preparation and reconstruction. The repaired neurons are placed in a database from which statistics for the different anatomical classes of neurons are obtained .These statistics are used to clone an indeﬁnite number of neurons in each class to capture the full morphological diversity. The next step is to take each neuron and insert ion channel models in order to produce the array of electrical types. The ﬁeld has reached a sufﬁcient stage of convergence to generate efforts to classify neurons, such as the Petilla Convention - a conference held in October 2005 on anatomical and electrical types of neocortical interneuron, established by the community. Single cell gene expression studies of neocortical interneurons now provide detailed predictions of the speciﬁc combinations of more than 20 ion channel genes that underlie electrical diversity. A database of biologically accurate Hodgkin-Huxley ion channel models is being produced. The simulator NEURON is used with automated ﬁtting algorithms running on Blue Gene to insert ion channels and adjust their parameters to capture the speciﬁc electrical properties of the different electrical types found in each anatomical class.

 The statistical variations within each electrical class are also used to generate subtle variations in discharge behaviour in each neuron. So, each neuron is morpho-logically and electrically unique. Rather than taking 10,000 days to ﬁt each neuron’s electrical behaviour with a unique proﬁle, density and distribution of ion channels, applications are being prepared to use Blue Gene to carry out such a ﬁt in a day. These functionalized neurons are stored in a database. The three-dimensional neurons are then imported into Blue Builder, a circuit builder that loads neurons into their layers according to a “recipe” of neuron numbers and proportions.  A collision detection algorithm is run to determine the structural positioning of all axodendritic touches , and neurons are jittered and spun until the structural touches match experimentally derived statistics. Probabilities of connectivity between different types of neuron are used to determine which neurons  are connected, and all axo-dendritic touches are converted into synaptic connections. The manner in which the axons map onto the dendrites between speciﬁc anatomical classes and the distribution of synapses received by a class of neurons are used to verify and ﬁne-tune the biological accuracy of the synaptic mapping between neurons.

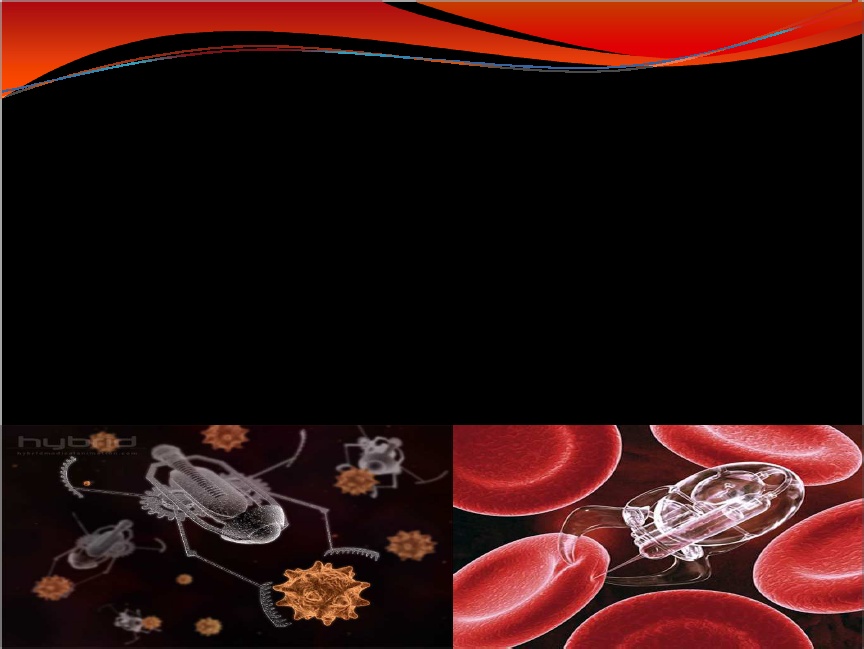


Fig 5.1 Nanobots

It is therefore possible to place 10-50 millionsynapses in accurate three-dimensional space, distributed on the detailed three dimensional morphology of each neuron. The synapses are functionalized according to the synaptic parameters for different classes of synaptic connection within statistical variations of each class, dynamic synaptic models are used to simulate transmission, and synaptic learning algorithms are introduced to allow plasticity. The distance from the cell body to each synapse is used to compute the axonal delay, and the circuit conﬁguration is exported. The conﬁguration ﬁle is read by a NEURON subroutine that calls up each neuron and effectively inserts the location and functional properties of every synapse on the axon, soma and dendrites. One neuron is then mapped on to each processor and the axonal delays are used to manage communication between neurons and processors.

 Effectively, processors are converted into neurons, and MPI (message-passing interface)- based communication cables are converted into axonsinter connecting the neurons - so the entire Blue Gene is essentially converted into an eocortical microcircuit. We developed two software programs for simulating such large-scale networks with morphologically complex neurons. A new MPI version of NEURON has been adapted by Michael Hines to run on Blue Gene. The second simulator uses the MPI messaging component of the large-scale NeoCorticalSimu-lator (NCS), which was developed by Philip Goodman, to manage the communicationbetween NEURON-simulated neurons distributed on different processors.

 The latter simulator will allow embedding of a detailed NCC model into a simpliﬁed large-scale model of the whole brain. Both of these softwares have already been tested, produce identical results and can simulate tens of thousands of morphologically and electrically complex neurons (as many as 10,000 compartments per neuron with more than a dozen Hodgkin-Huxley ion channels per compartment). Up to 10 neurons can be mapped onto each processor to allow simulations of the NCC with as many as 100,000neurons. Optimization of these algorithms could allow simulations to run at close to real time. The circuit conﬁguration is also read by a graphic application, which renders the entire circuit in various levels of textured graphic formats. Real-time stereo visu-alization applications are programmed to run on the terabyte SMP (shared memory processor) Extreme series from SGI (Silicon Graphics, Inc.). The output from BlueGene (any parameter of the model) can be fed directly into the SGI system to perform in silico imaging of the activity of the inner workings of the NCC.

**Whole Brain Simulations**

The main limitations for digital computers in the simulation of biological processes are the extreme temporal and spatial resolution demanded by some biological processes, and the limitations of the algorithms that are used to model biological processes. If each atomic collision is simulated, the most powerful super-computers still take days to simulate a micro second of protein folding, so it is, of course, not possible  to simulate  complex biological systems at the atomic scale.However, models at higher levels, such as the molecular or cellular levels, can capture lower-level processes and allow complex large-scale simulations of biological processes. The Blue Brain Project’s Blue Gene can simulate a NCC of up to 100,000 highly complex neurons at the cellular or as many as 100 million simple neurons (about the same number of neurons found in a mouse brain).

 However, simulating neurons embedded in microcircuits, microcircuits embedded in brain regions, and brain regions embedded in the whole brain as part of the process of understanding the emergence of complex behaviors of animals is an inevitable progression in understanding brain function and dys function, and the question is whether whole-brain simulations area all possible. Computational power needs to increase about 1-million-fold before we will be able to simulate the human brain, with 100 billion neurons, at the same level of detail as the Blue Column. Algorithmic and simulation efﬁciency (which ensure that all possible FLOPS are exploited) could reduce this requirement by two to three orders of magnitude.

 Simulating the NCC could also act as a test-bed to reﬁne algorithms required to simulate brain function, which can be used to produce ﬁeld programmable gate array (FPGA)-based chips. FPGAs could increase computational speeds by as much as two orders of magnitude. The FPGAs could, in turn, provide the testing ground for the production of specialized NEURON solver application-speciﬁc integrated circuits (ASICs) that could further increase computational speed by another one to two orders of magnitude. It could therefore be possible, in principle, to simulate the human brain even with current technology. The computer industry is facing what is known as a discontinuity, with increasing processor speed leading to unacceptably high power consumption and heat production. This is pushing a qualita-tively new transition in the types of processor to be used in future computers. These advances in computing should begin to make genetic- and molecular-level simulations possible. Software applications and data manipulation required to model the brain with biological accuracy.

Experimental results that provide the elementary building blocks of the microcircuit are stored in a database. Before three-dimensional neurons are modelled electrically, the morphology is parsed for errors, and for repair of arborizations damaged during slice preparation.

**6. APPLICATIONS OF BLUE BRAIN PROJECT**

Detailed, biologically accurate brain simulations offer the opportunity to answer some fundamental questions about the brain that cannot be addressed with any current experimental or theoretical approaches. These include,

**Deﬁning functions of the basic elements**

Despite a century of experimental and theoretical research, we are unable to provide a comprehensive deﬁnition of the computational function of different ion channels, receptors, neurons or synaptic pathways in the brain. A detailed model will allow ﬁne control of any of these elements and allow a systematic investigation of their contribution to the emergent behaviour.

**Understanding complexity**

At present, detailed, accurate brain simulations are the only approach that could allow us to explain why the brain needs to use many different ion channels, neurons and synapses, aspectrum of receptors, and complex dendritic and axonalar borizations ,rather than the simpliﬁed, uniform types found in many models.

**Exploring the role of dendrites.**

This is the only current approach to explore the dendritic object theory, which proposes that three-dimensional voltage objects are generated continuously across dendritic segments regardless of the origin of the neurons, and that spikes are used to maintain such dendritic objects.

**Revealing functional diversity**

Most models engineer a speciﬁc function, whereas a spectrum of functions might be possible with a biologically based design. Understanding memory storage and retrieval. This approach offers the possibility of determining the manner in which representations of information are imprinted in the circuit for storage and retrieval, and could reveal the part that different types of neuron play in these crucial functions.

**Tracking the emergence of intelligence**

This approach offers the possibility to re-trace the steps taken by a network of neurons in the emergence of electrical states used to embody representations of the organism and its world.

**Identifying points of vulnerability**

Although the neocortex confers immense computational power to mammals ,defects are common, with catastrophic cognitive effects. At present, a detailed model is the only approach that could produce a list of the most vulnerable circuit parameters, revealing likely candidates for dysfunction and targets for treatment.

**Simulating disease and developing treatments**

Such simulations could be used to test hypotheses for the pathogenesis of neurological and psychiatric diseases, and to develop and test new treatment strategies.

**Applications of Blue Brain**

**Gathering and Testing 100 Years of Data**

The most immediate beneﬁt is to provide a working model into which the past100 years knowledge about the microstructure and workings of the neocortical column can be gathered and tested. The Blue Column will therefore also produce a virtual library to explore in 3D the micro architecture of the neocortex and access all key research relating to its structure and function.

**Cracking the Neural Code**

The Neural Code refers to how the brain builds objects using electrical patterns. In the same way that the neuron is the elementary cell for computing in the brain, the NCC is the elementary network for computing in the neocortex. Creating an accuratereplica of the NCC which faithfully reproduces the emergent electrical dynamics of thereal microcircuit, is an absolute requirement to revealing how the neocort exprocesses ,stores and retrieves information.

**Understanding Neocortical Information Processing**

The power of an accurate simulation lies in the predictions that can begenerated about the neocortex. Indeed, iterations between simulations and exper-iments are essential to build an accurate copy of the NCC. These iterations aretherfore expected to reveal the function of individual elements (neurons, synapses, ion channels, receptors), pathways (mono-synaptic, disynaptic , multisynaptic loops) and physiological processes  (functional properties, learning, reward, goal oreinted behavior).

**A Novel Tool for Drug Discovery for Brain Disorders**

Understanding the functions of different elements and pathways of the NCC will provide a concrete foundation to explore the cellular and synaptic bases of a wide spectrum of neurologyical and psychiatric is eases. The impact of receptor, ion channel ,cellular and synaptic deﬁcits could be tested in simulations and the optimal experimental tests can be determined.

**A Global Facility**

A software replica of a NCC will allow researchers to explore hypotheses of brain function and dysfunction accelerating research. Simulation runs could determine which parameters should be used and measured in the experiments. An advanced 2D, 3D and 3D immersive visualization system will allow “imaging” of many aspects of neural dynamics during processing, storage and retrieval of information. Such imaging experiments may be impossible in reality or may be prohibitively expensive to perform.

**A Foundation for Whole Brain Simulations**

With current and envisage able future computer technology it seems unlikely that a mammalian brain can be simulated with full cellular and synaptic complexity (above the molecular level). An accurate replica of an NCC is therefore required in order to generate reduced models that retain critical functions and computational capabilities, which can be duplicated and interconnected to form neocortical brain regions .Knowledge of the NCC architecture can be transferred to facilitate reconstruction of subcortical brain regions.

**A Foundation for Molecular Modeling of Brain Function**

An accurate cellular replica of the neocortical column will provide the ﬁrst andessential step to a gradual increase in model complexity moving towards a molecular level description of the neocortex with biochemical pathways being simulated. A molecular level model of the NCC will provide the substrate for interfacing gene expression with the network structure and function. The NCC lies at the interface between the genes and complex cognitive functions. Establishing this link will allow predictions of the cognitive consequences of genetic disorders and allow reverse engi-neering of cognitive deﬁcits to determine the genetic and molecular causes. This level of simulation will become a reality with the most advanced phase of Blue Gene development.

**7 .ADVANTAGES AND LIMITATION**

**Advantages**

* We can remember things without any effort.
* Decision can be made without the presence of a person.
* Even after the death of a man his intelligence can be used.
* The activity of different animals can be understood. That means by interpre-tation of the electric impulses from the brain of the animals, their thinking canbe understood easily.
* It would allow the deaf to hear via direct nerve stimulation, and also be helpfulfor many psychological diseases. By down loading the contents of the brain thatwas uploaded into the computer, the man can get rid from the madness.

**Limitations**

* Further, there are many new dangers these technologies will open. We will besusceptible to new forms of harm.
* We become dependent upon the computer systems.
* Others may use technical knowledge against us.
* Computer viruses will pose an increasingly critical threat.

The real threat, however, is the fear that people will have of new technologies . That fear may culminate in a large resistance. Clear evidence of this type of fear is found today with respect to human cloning.

**8. FUTURE PERSPECTIVE**

The synthesis era in neuroscience started with the launch of the Human Brain Project and is an inevitable phase triggered by a critical amount of fundamental data .The data set does not need to be complete before such a phase can begin. Indeed, it is essential to guide reductionist research into the deeper facets of brain structure and function. As a complement to experimental research, it offers rapid assessment of the probable effect of a new ﬁnding on preexisting knowledge, which can no longer be managed completely by any one researcher.

 Detailed models will probably become the ﬁnal form of databases that are used to organize all knowledge of the brain and allow hypothesis testing, rapid diagnoses of brain malfunction, as well as development of treatments for neurological disorders. In short, we can hope to learn a great deal about brain function and disfunction from accurate models of the brain .

The time taken to build detailed models of the brain depends on the level of detail that is captured. Indeed, the ﬁrst version of the Blue Column, which has 10,000 neurons, has already been built and simulated; it is the reﬁnement of the detailed properties and calibration of the circuit that takes time. A model of the entire brain at the cellular level will probably take the next decade.

There is no fundamental obstacle to modeling the brain and it is therefore likely that we will have detailed models of mammalian brains ,including that of man, in the near future. Even if overestimated by a decade or two, this is still just a ’blink of an eye’ in relation to the evolution of human civilization. As with Deep Blue, Blue Brain will allow us to challenge the foundations of our understanding of intelligence and generate new theories of consciousness.

**9. CONCLUSION**

In conclusion, we will be able to transfer ourselves into computers at some point. Most arguments against this outcome are seemingly easy to circumvent. They are either simple minded, or simply require further time for technology to increase. The only serious threats raised are also overcome as we note the combination of biological and digital technologies.

**REFERENCES**

 “EngineeringinMedicineandBiologySociety”, 2008.EMBS2008.30thAnnualInternational Conference of the IEEE

 Henry Markram, “The Blue Brain Project”, Nature Reviews Neuroscience 2006February.

 Simulated brain closer to thought BBC News 22 April 2009.

 “ProjectMilestones”.BlueBrain.http://bluebrain.epﬂ.ch/Jahia/site/bluebrain/op/edit/pid/19085

Graham-Rowe, Duncan. “Mission to build a simulated brain begins”, NewSci-entist, June 2005. pp. 1879-85.

Blue Gene: <http://www.research.ibm.com/bluegene>

The Blue Brain Project: http://bluebrainproject.epﬂ.ch27

www.artificialbrains.com/bluebrain

www.nanobot.info/