

# Research: Why and How

Prabhas Chongstitvatana  
Department of Computer Engineering  
Chulalongkorn University

<http://www.cp.eng.chula.ac.th/~piak/>

# My research works

Research area:

Evolutionary computation

Genetic Algorithm

Genetic Programming

Evolution Strategy

Machine Learning

Artificial Neuron Network

Decision Tree

Inductive Logic Program

Support Vector Machine

Embedded Systems

Virtual Machines

Special-purpose Programming Languages

Embedded Processors

Reconfigurable Circuits

Design by Evolution

Robot Programs

Digital Circuits

Finite State Machines

## Algorithms

- Building Blocks

- Compressed Representation

- Multiple Objectives Optimisation

- Genetic Algorithm Circuits

- Parallelisation

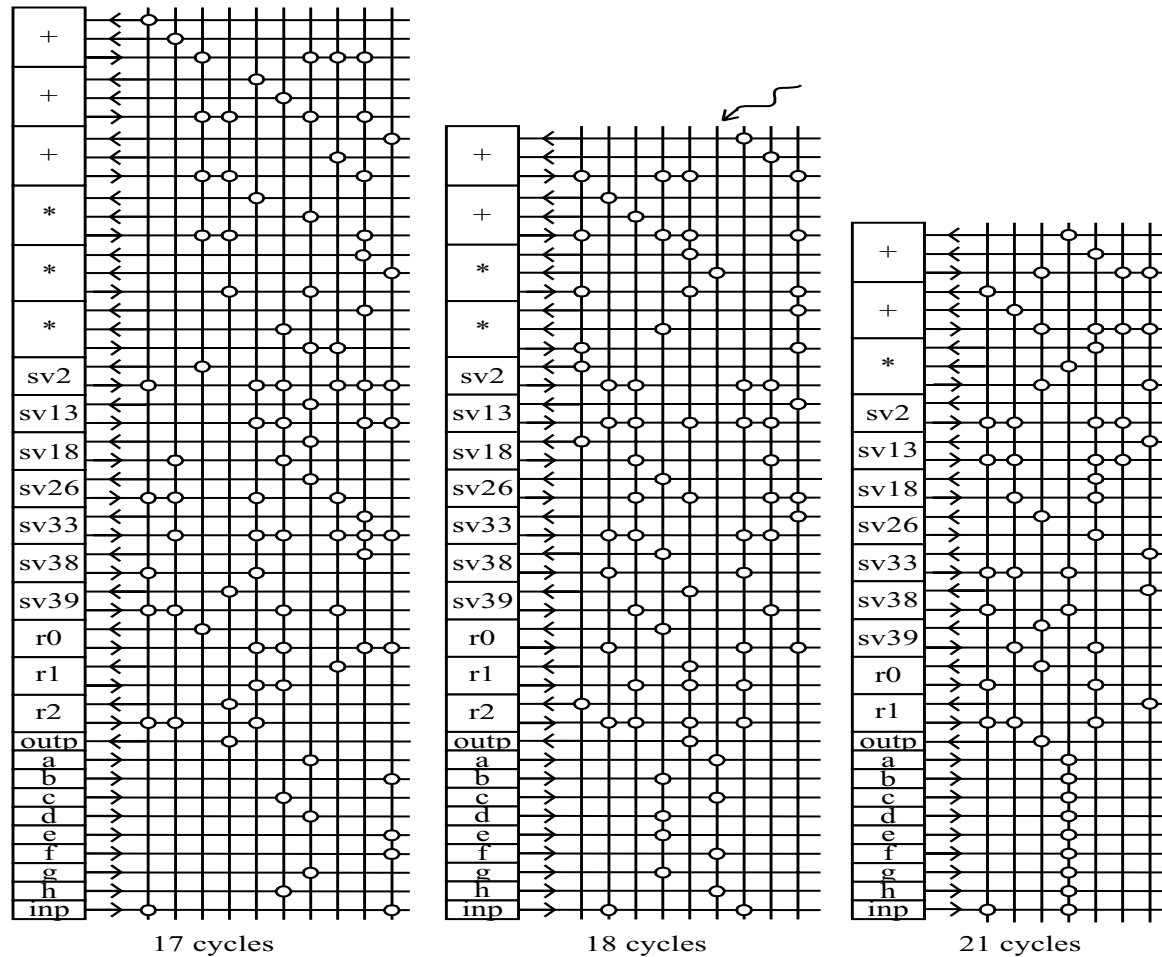
## Robotics

## Applications

- Bioinformatics

- Forecasting

- 3-d bin packing



## High level synthesis by Ant algorithm

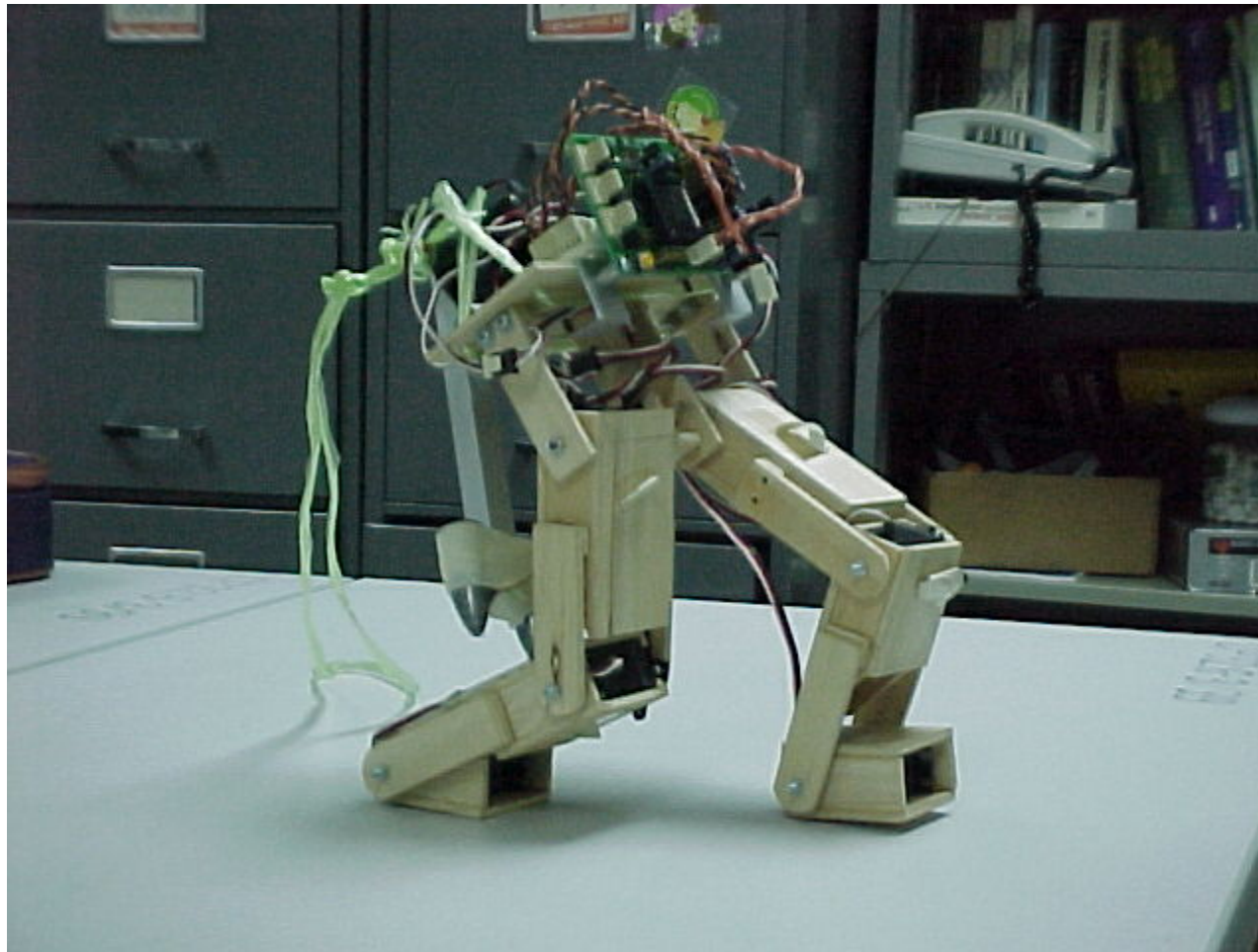
```

 $M = (m_{ij})$  denotes  $\ell \times \ell$  chi-square matrix.
 $T_i$  and  $R_{i,j}$  denote arrays of numbers.
 $A$  and  $B$  are partition subsets.
 $P$  denotes a partition.

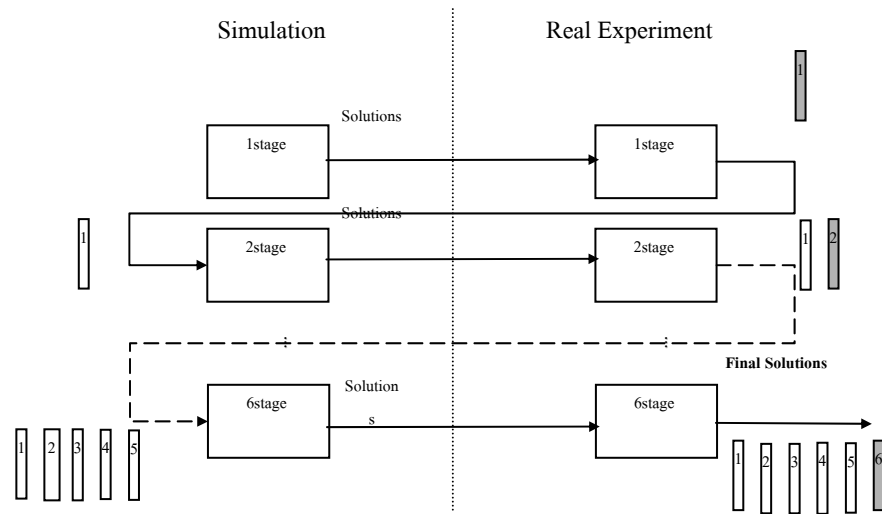
Algorithm PAR( $M, \alpha$ )
 $P \leftarrow \emptyset$ ;
for  $i = 1$  to  $\ell$  do // outer loop
  if  $i \notin B$  for all  $B \in P$  then
     $T \leftarrow \{\text{row } i \text{ sorted in desc. order}\}$ ;
    for  $j = 1$  to  $\ell$  do
       $R_{i,j} \leftarrow x$  where  $m_{ix} = T_j$ ;
    endfor
     $A \leftarrow \{i\}$ ;
     $B \leftarrow \{i\}$ ;
    for  $j = 1$  to  $\ell - 2$  do // inner loop
       $A \leftarrow A \cup \{R_{i,j}\}$ ;
      if  $A$  satisfies cond. 3.1 and 4.1 then
         $B \leftarrow A$ ;
      endif
    endfor
     $P \leftarrow P \cup \{B\}$ ;
  endif
endfor
return  $P$ ;

```

**Fig. 9.** Algorithm PAR takes an  $\ell \times \ell$  symmetric matrix,  $M = (m_{ij})$ . The output partition of  $\{1, \dots, \ell\}$



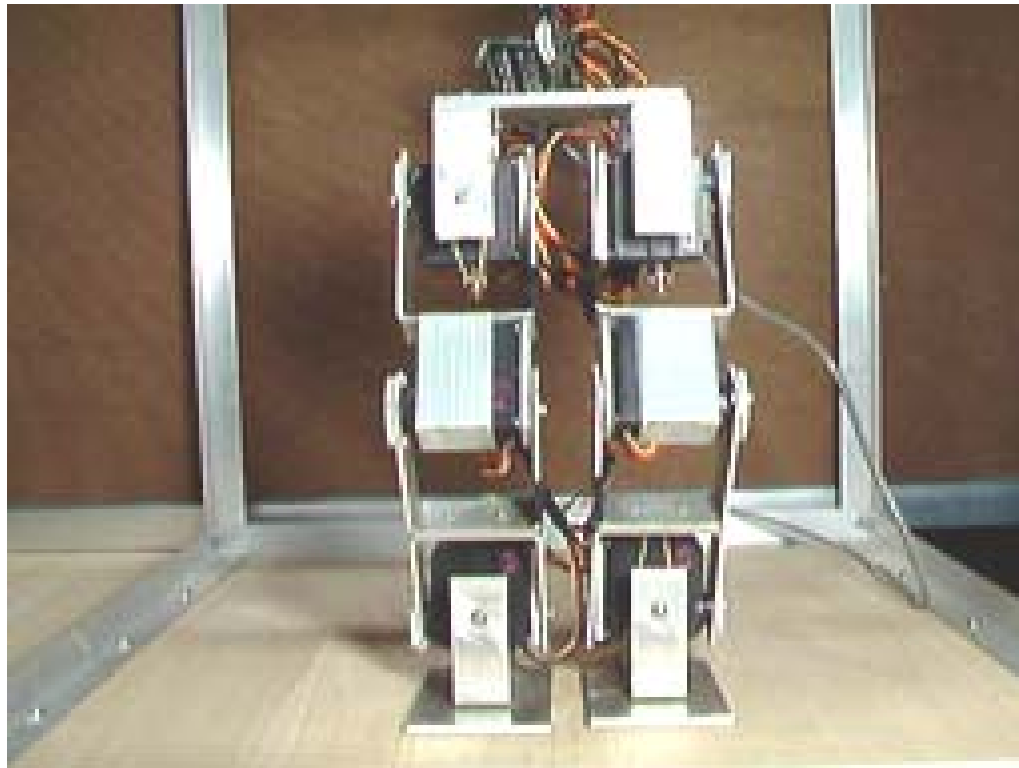
Synthesis of biped waling program by evolution



## Staged evolution with real-world embedding

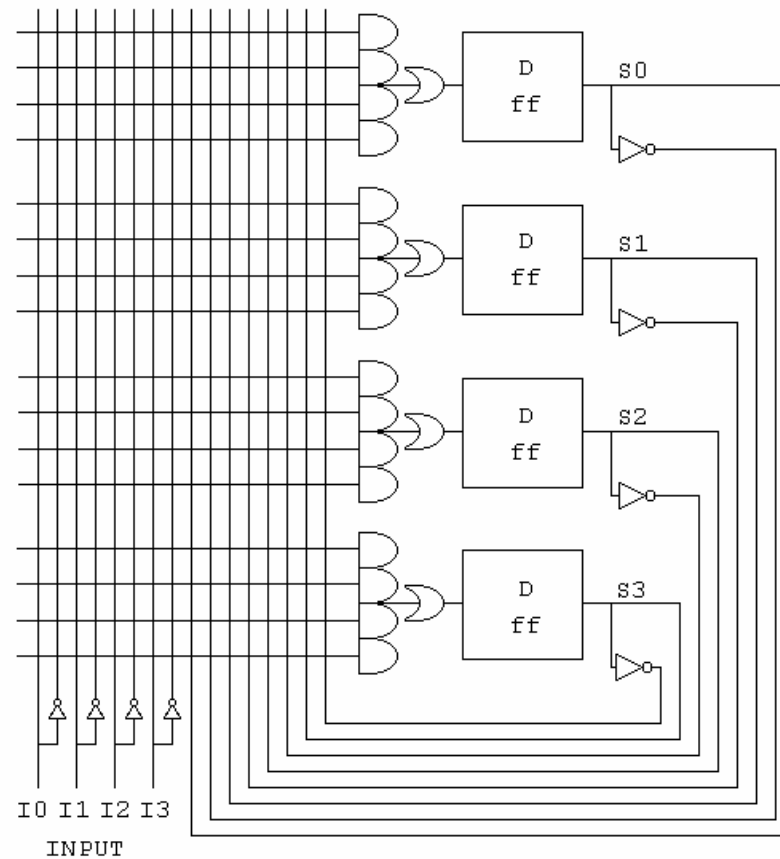


## second generation 10 DOF biped

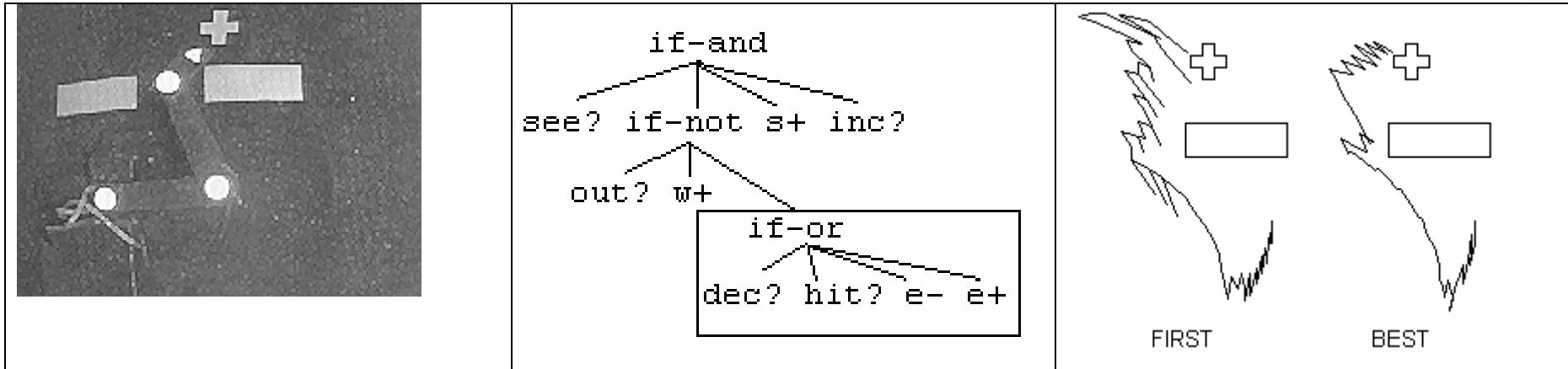




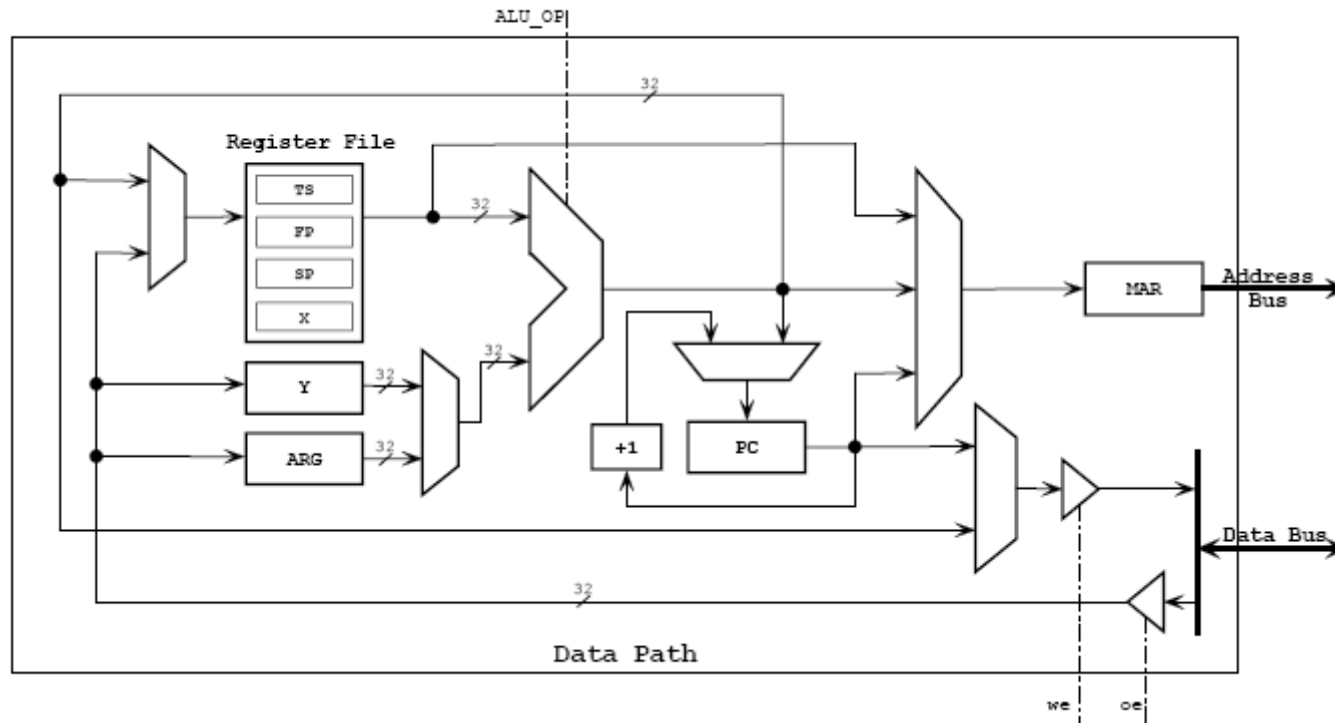
## synthesis of life-like plants



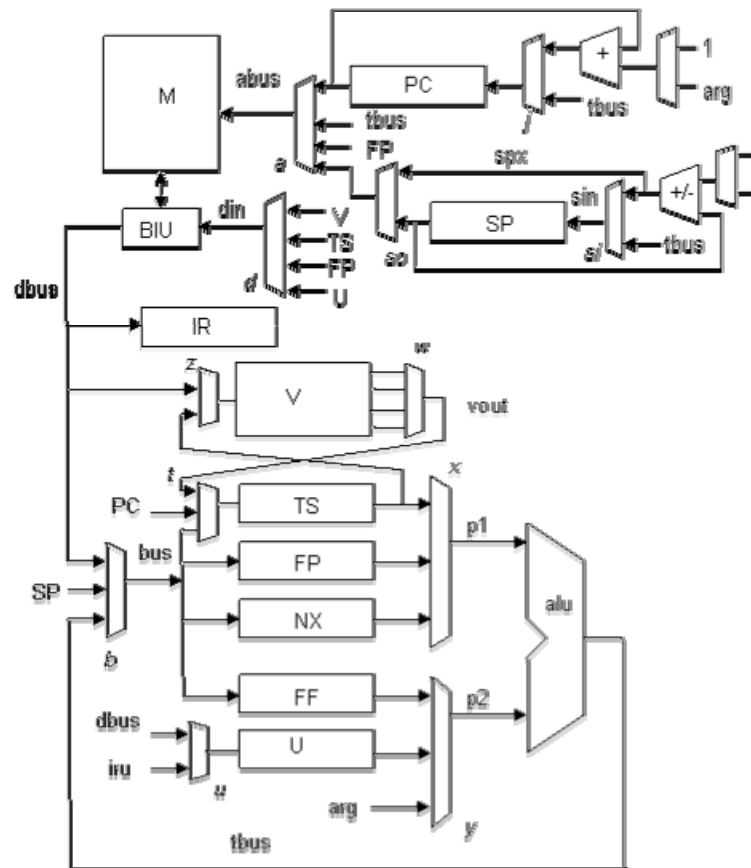
## Synthesis of sequential circuits



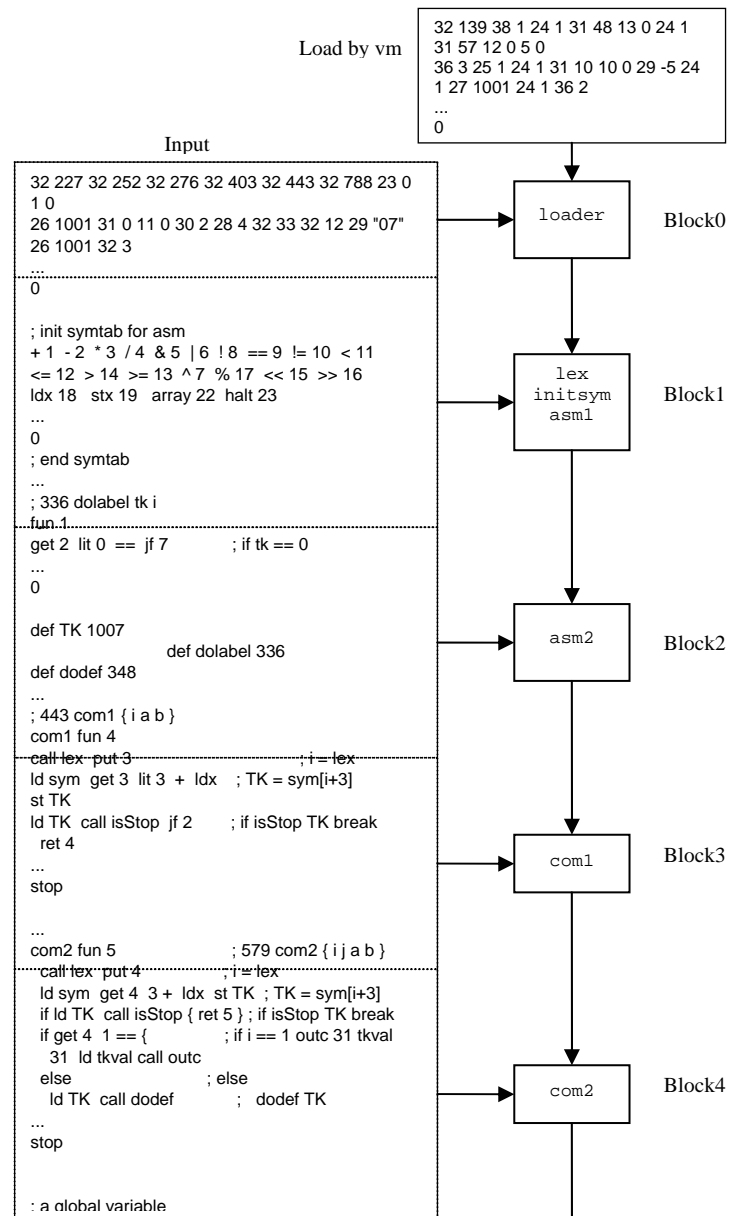
## Synthesis of robot arm control program



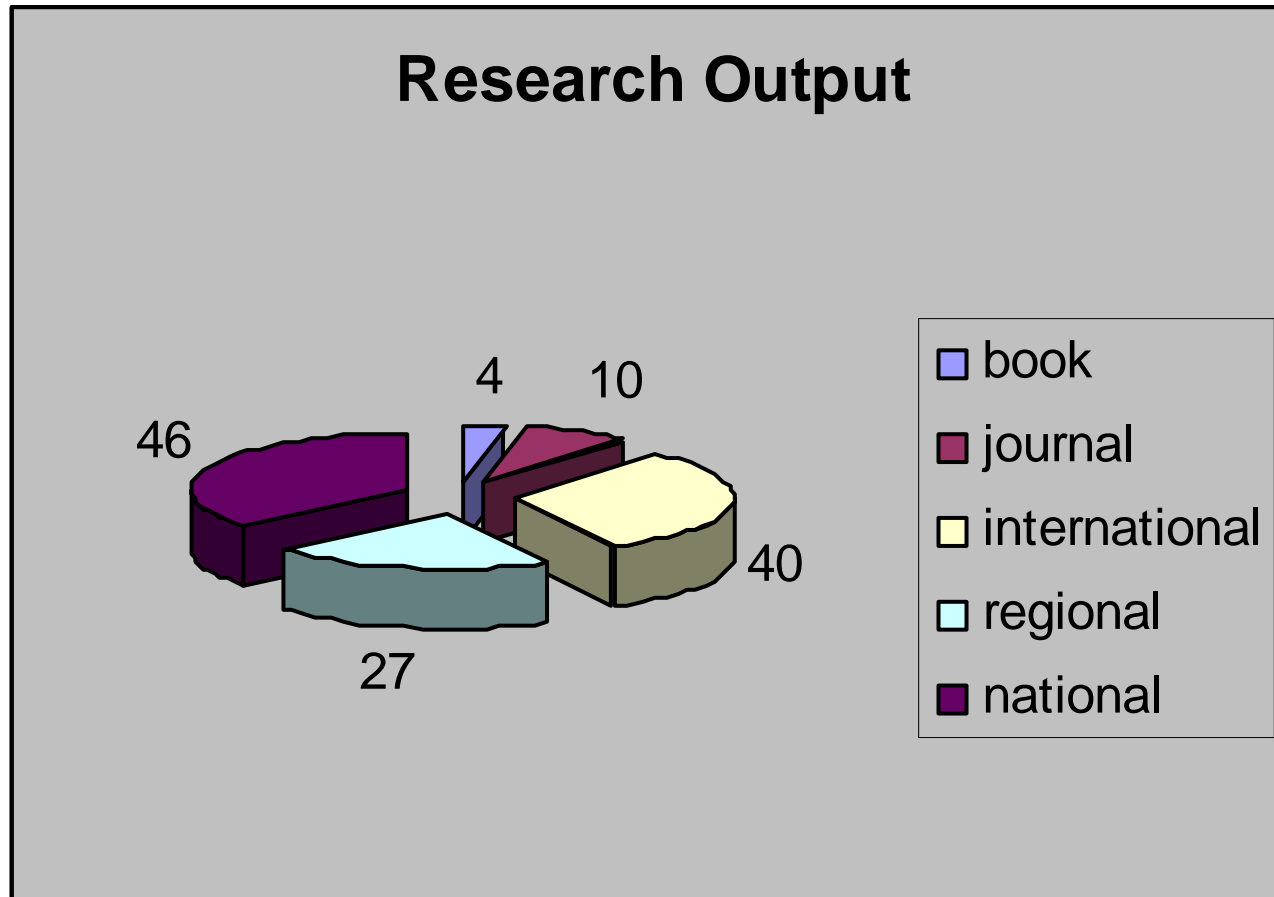
Stack-based resource efficient processor



## Stack-caching for performance improvement



# Self-generating Compiler





# Research Students Graduated

Master 30  
Doctor 5

current: Master 3, Doctor 4

# Research as an Evolution

Ph.D

work with students

funding agency

applications

multi-discipline





True success is not in the learning, but  
in its application to the benefit of mankind.

M. Sonthala