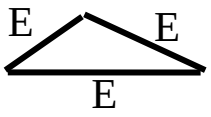
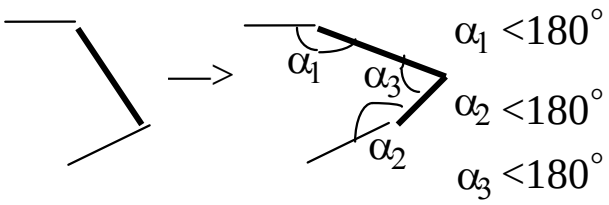
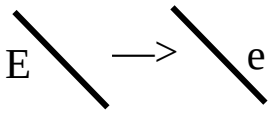
Assignment 11. Due 04/25/11.

1. What language can be generated by the following grammar? Show a derivation. Prove that this grammar generates **exactly** this language.

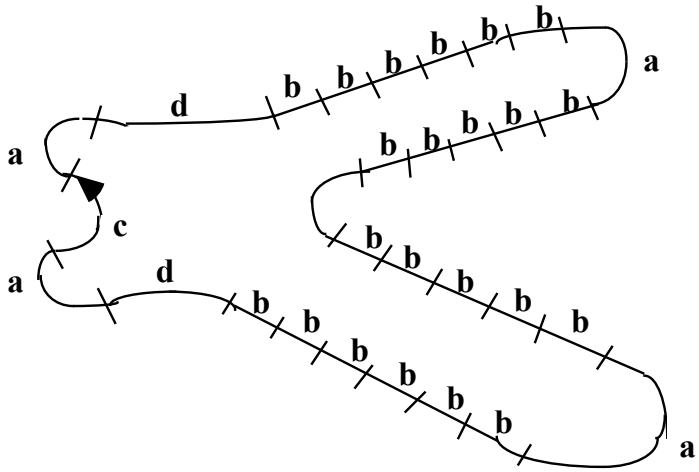
$G = (V_T, V_N, P, S)$, $V_T = \{.\ e\ .\}$, $V_N = \{S, E\}$,
where E is an auxiliary segment. Productions are as follows:

1) S —> 

2) 

3) 

2. Construct a grammar, which can generate the acrocentric chromosome shown below.



cadbbbbbbabbbbbcbbbbbabbbbbbda

3. Construct a plex-grammar generating the flow-chart shown in class (example No. 5 in the **next handout**).
4. What chromosome language can be generated by the grammar from example No. 5 in **this handout**? Show chromosomes and derivation (**Extra Credit**).

Graph Grammars **(Pavlidis)**

$$G = (V_T, V_N, P, S)$$

V_T - terminal symbols - consists of arcs and nodes

V_N - nonterminal symbols - auxiliary structures, i.e. nodes, arcs, triangles, and polygons with no more than ***m*** nodes

P - finite set of productions of the form

$$\mathbf{A} \longrightarrow \alpha,$$

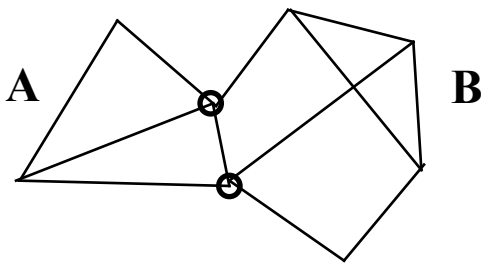
where

$A \in V_N$,

α - graph, which consists of terminal and nonterminal structures, α is connected with the rest of the graph via the same nodes as **A.**

S is the start symbol

Expression A * B means that graphs A and B are connected via exactly two nodes



Production C —> A * B means that subgraph C should be replaced with A and B;

A and B should be connected with the rest of the graph via the same nodes as C was.

Examples

1. Grammar of sequential and parallel circuits

$G = (V_T, V_N, P, S)$

$V_N = \{S, B\}$, B - auxiliary arc

$V_T = \{$ **b** , o**n** $\}$

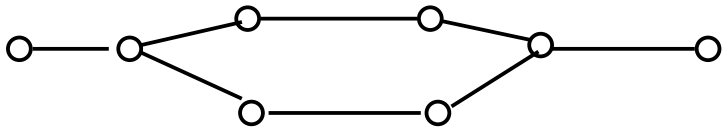
P consists of

1) S —> nBn S —> o—o

2) B —> BnB — —> —o—

3) B —> B * B — —>

4) B —> b — —> **b**



1 **2** **2**

S => nBn => nBnBn => nBnBnBn

3 **2**

=> nBn(B*B)nBn => nBn((BnB)*B)nBn

2 **2**

=> nBn((BnBnB)*B)nBn => nBn((BnBnB)*(BnB))nBn

2 **4** **4**

=> nBn((BnBnB)*(BnBnB))nBn =>. . . . . .=>

4

=> **n b n b n b n b n b n**

b b

n b n

2. Grammar of trees

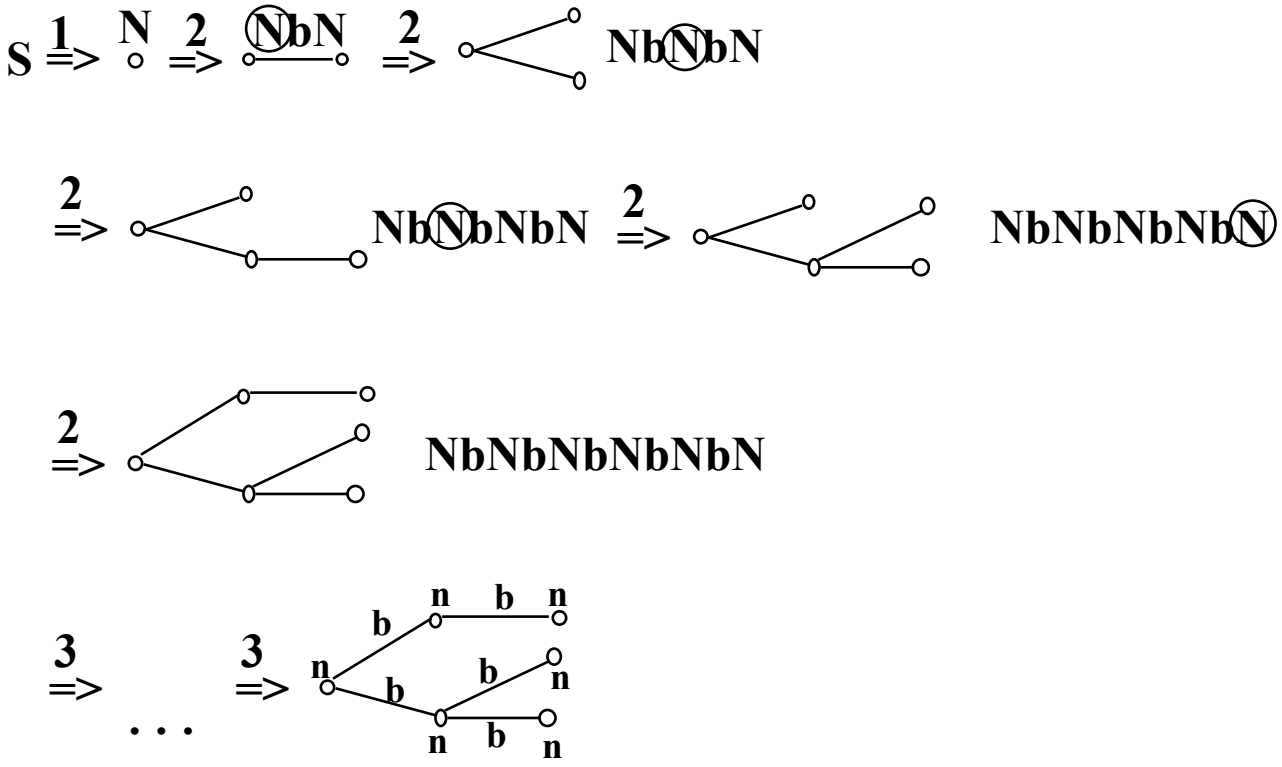
$G = (V_T, V_N, P, S)$

$V_N = \{N, S\}$, N - auxiliary node

$V_T = \{ \underline{\ b\ }\ ,\ {}_{o}{}^{n}\ \}$

P consists of

1) **S** —> **N**
2) **N** —> **NbN**
3) **N** —> **n**



"Chromosome" Grammars

3. Consider the following grammar

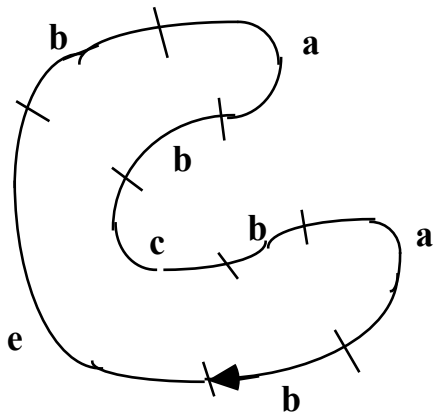
$$G = (V_T, V_N, P, S)$$

$V^{(3)}_T = \{$  $\}$

V_N = { S, < pair of shoulders >, < left part >,
< right part >, < shoulder>, <arc>, <base> }

S = <V-chromosome >

Productions P:



bebabcba

1. < V-chromosome > —> <base> < pair of shoulders>
2. <pair of shoulders> —> <left part> <shoulder>
3. <left part> —> <shoulder> **c**
4. <base > —> **b** <base>
5. <base > —> **e**
6. <shoulder> —> **b** <shoulder>
7. <shoulder> —> <shoulder> **b**
8. <shoulder> —> **a**

Let us derive the string **bebabcba**
corresponding to V-chromosome:

S $\overset{1}{\Rightarrow}$ <base> <pair of shoulders>

$\overset{4}{\Rightarrow}$ **b** <base><pair of shoulders>

$\overset{5}{\Rightarrow}$ **be** <pair of shoulders>

$\overset{2}{\Rightarrow}$ **be** <left part><shoulder>

$\overset{3}{\Rightarrow}$ **be** <shoulder> **c** <shoulder>

$\overset{6}{\Rightarrow}$ **beb** <shoulder> **c** <shoulder>

$\overset{7}{\Rightarrow}$ **beb** <shoulder> **bc** <shoulder>

$\overset{8}{\Rightarrow}$ **bebabc** <shoulder>

$\overset{6}{\Rightarrow}$ **bebabcb** <shoulder>

$\overset{8}{\Rightarrow}$ **bebabcba**

4. Consider the following grammar

$G = (V_T, V_N, P, S)$

where

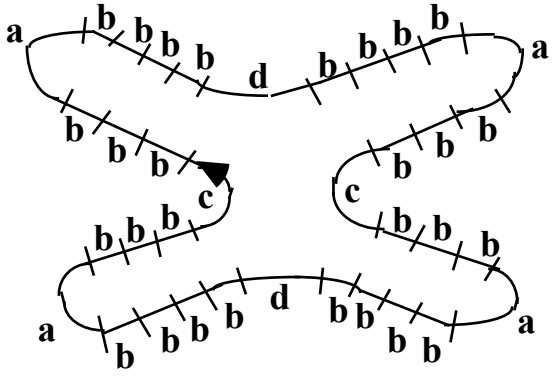
V_T = { a, b, c, d} the same primitives as in problem 3.

$V^{(3)}_T$ = { a , b , c , d , e }

V_N = { S, A, B, D, H, J, E, G}

1.	S —> AA	5.	D —> FDE	9.	H —> a
2.	A —> cB	6.	D —> d	10.	J —> a
3.	B —> FBE	7.	F —> b		
4.	B —> HDJ	8.	E —> b		

Show that this grammar generates the picture of the following X-chromosome



cbbbabbbbdbbbbabbbcbbbabbbbdbbbbabbb

$S \rightarrow^{1} AA \rightarrow^{2} cBA \rightarrow^{2} cBcB$

3 { $\rightarrow^{3} cFBEcB \rightarrow^{7} cbBEcB$; . . . . ; $\rightarrow^{3} cbbFBE^{4}cB \rightarrow^{7} cb^{3}BE^{3}cB$ }

$\rightarrow^{4}$ cb^3HDJE^3CB $\rightarrow^{9}$ cb^3aDJE^3cB

4 { $\rightarrow^{5}$ $cb^3aFDEJE^3cB$ $\rightarrow^{7}$ $cb^3abDEJE^3cB$; . . . . ; $\rightarrow^{5}$ $cb^3ab^3FDE^4JEcB$ $\rightarrow^{7}$ $cb^3ab^4DE^4JE^3cB$ }

. . . .

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5. Consider the following grammar

   $G = (V_T, V_N, P, S)$

   V_T = {a, b, c, d, e} the same primitives

$$V^{(3)}_T = \{ \text{a}, \text{b}, \text{c}, \text{d}, \text{e} \}$$

   $V_N = \{S, S_1, S_2, A, B, C, D, E, F\}$

P:

1. S —> S_1	6. B —> e	11. S —> S_2	16. C —> bC
2. S_1 —> AA	7. C —> Cb	12. S_2 —> BA	17. C —> b
3. A —> CA	8. C —> d	13. A —> AC	18. D —> bD
4. A —> DE	9. D —> Db	14. A —> FD	19. D —> a
5. B —> bB	10. E —> cD	15. B —> Bb	20. F —> Dc

What chromosome language can be generated by this grammar? (**Extra credit**)