

Game playing



Kenapa mempelajari games?

- Kriteria menang atau kalah jelas
- Dapat mempelajari permasalahan
- Alasan histori
- Menyenangkan
- Biasanya mempunyai search space yang besar (misalnya game catur mempunyai 35^{100} nodes dalam search tree dan 10^{40} legal states)

Seberapa hebat computer game player?

– **Catur:**

- Deep Blue mengalahkan Gary Kasparov pada tahun 1997
- Gary Kasparov vs. Deep Junior (Feb 2003): seri

– **Checkers:**

- Chinook adalah juara dunia

– **Go:**

- Computer player adalah sangat tangguh

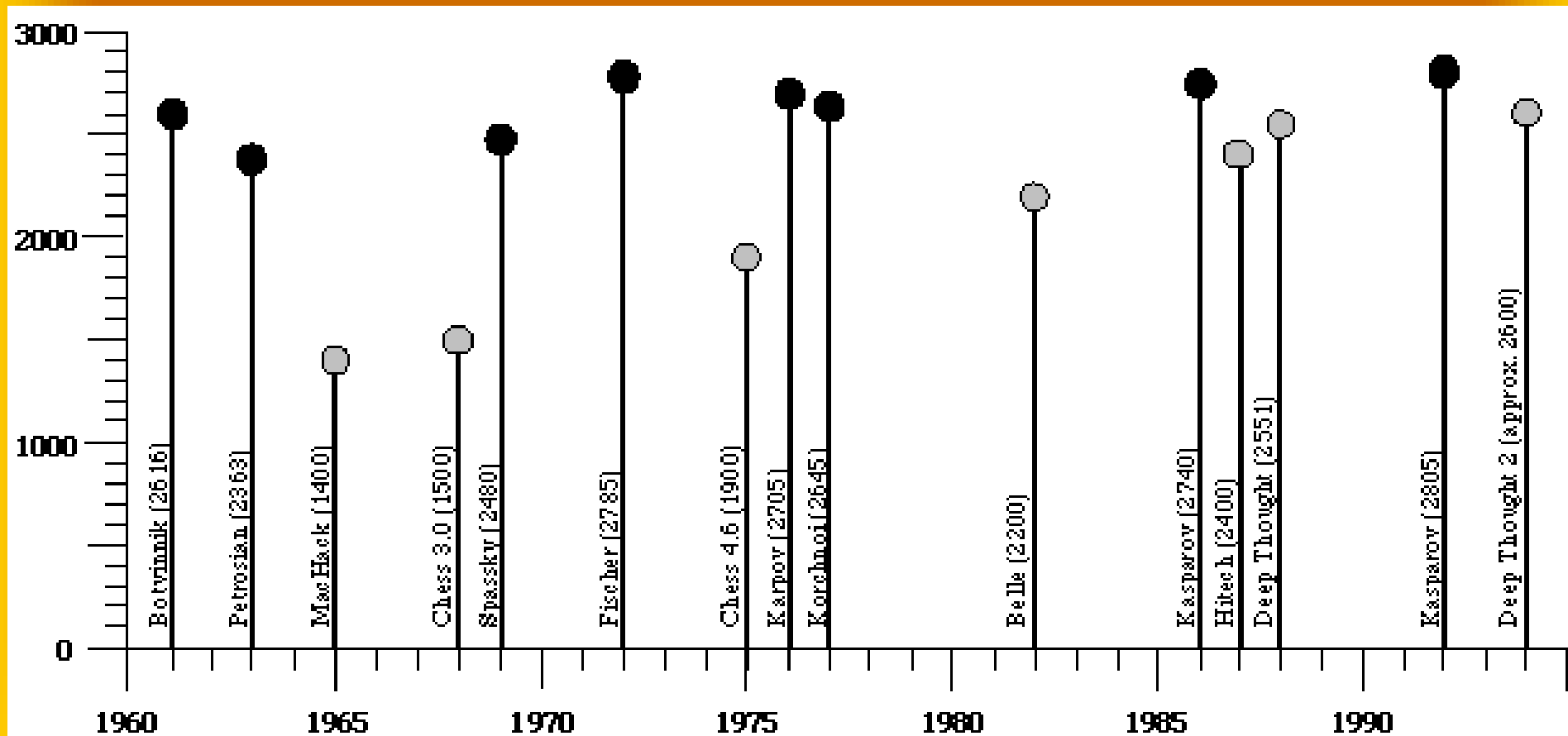
– **Bridge:**

- computer players mempunyai “Expert-level”



**Garry Kasparov and Deep Blue. © 1997,
GM Gabriel Schwartzman's Chess Camera, courtesy IBM.**

Ratings of human and computer chess champions



Kasparov vs. Deep Blue: The Rematch - Netscape

File Edit View Go Communicator Help

Bookmarks Location: http://www.chess.ibm.com/home/html/b.html

may 11th game 6: may 11 @ 3:00PM EDT | 19:00 GMT kasparov 2.5 deep blue 2.5

Home The match The players The technology Community

Deep Blue Wins

3.5 to 2.5

KASPAROV vs DEEP BLUE

the rematch

With a dramatic victory in Game 6, Deep Blue won its six-game rematch with Champion Garry Kasparov

OVERVIEW
EVENT COVERAGE
MATCH NEWS
MAIN STORIES



Commentary
George F. Papp, on chess, Kasparov, and the limitations of computers
[Read the article](#)



Club Kasparov
Visit the virtual home of the world's greatest chess player.



Community
During the rematch, more than 20,000 people from 120 countries joined the community to talk about the match.



Commentary
Vishwanath Anand on the legacy of Kasparov vs. Deep Blue
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Guest essays
Thoughts on chess, computers, and what it all means
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Clips from the rematch
Video footage from the games
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January/February 2003

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Kasparov-Deep Junior draw after stunning sacrifice
06.02.2003 Garry Kasparov was determined to win his last white game against the computer. But on move ten Deep Junior produced a stunning piece sacrifice that left its opponent reeling. It's unclear if the combination was sound, but Kasparov was not going to test it over the board. He quickly forced a draw by repetition to keep the score level at 2½:2½. Read our illustrated report

 **3D presents: The First F.I.D.E. Official World Chess Championship**
MAN (Kasparov) VS MACHINE (Deep Junior)



	X3D World	FIDE	Reports	Schedule	Live cov
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Score

	1	2	3	4	5	6	total
Garry Kasparov	1	½	0	½	½		2½
Deep Junior	0	½	1	½	½		2½

HAL or Tal? Junior Stuns Kasparov in Game Five

Game five of the Kasparov-Deep Junior match was the shortest game so far, just 19 moves. It ended in a draw after Junior played a bishop sacrifice on move 10 that led the game to a perpetual check draw. A stunned Kasparov found the best moves to survive the black attack, but he declined to play a risky attempt to continue the game on move 16. The match is tied 2.5-2.5, setting up a high-stakes battle in Friday's

Ciri umum pada game

- 2 pemain
- Kesempatan pemain bergantian
- Zero-sum: kerugian seorang pemain adalah keuntungan pemain lain
- Perfect information: pemain mengetahui semua informasi state dari game
- Tidak mengandung probabilitas (seperti dadu)
- Contoh: Tic-Tac-Toe, Checkers, Chess, Go, Nim, Othello
- Game tidak termasuk Bridge, Solitaire, Backgammon, dan semisalnya

Bagaimana bermain game?

- Cara bermain game:
 - Pertimbangkan semua kemungkinan jalan
 - Berikan nilai pada semua kemungkinan jalan
 - Jalankan pada kemungkinan yang mempunyai nilai terbaik
 - Tunggu giliran pihak lawan jalan
 - Ulangi cara diatas
- Key problems:
 - Representasikan “board” atau “state”
 - Buatlah next board yang legal
 - Lakukan evaluasi pada posisi

Evaluation function

- Evaluation function atau static evaluator digunakan untuk mengevaluasi nilai posisi yang baik
- Zero-sum assumption membolehkan untuk menggunakan single evaluation function untuk mendeskripsikan nilai posisi
 - $f(n) \gg 0$: posisi n baik untuk saya dan jelek untuk lawan
 - $f(n) \ll 0$: posisi n jelek untuk saya dan baik untuk lawan
 - $f(n)$ near 0 : posisi n adalah posisi netral/seri
 - $f(n) = +\text{infinity}$: saya menang
 - $f(n) = -\text{infinity}$: lawan menang

Contoh evaluation function

- Tic-Tac-Toe

$$f(n) = [\text{\# of 3-lengths open for me}] - [\text{\# of 3-lengths open for you}]$$

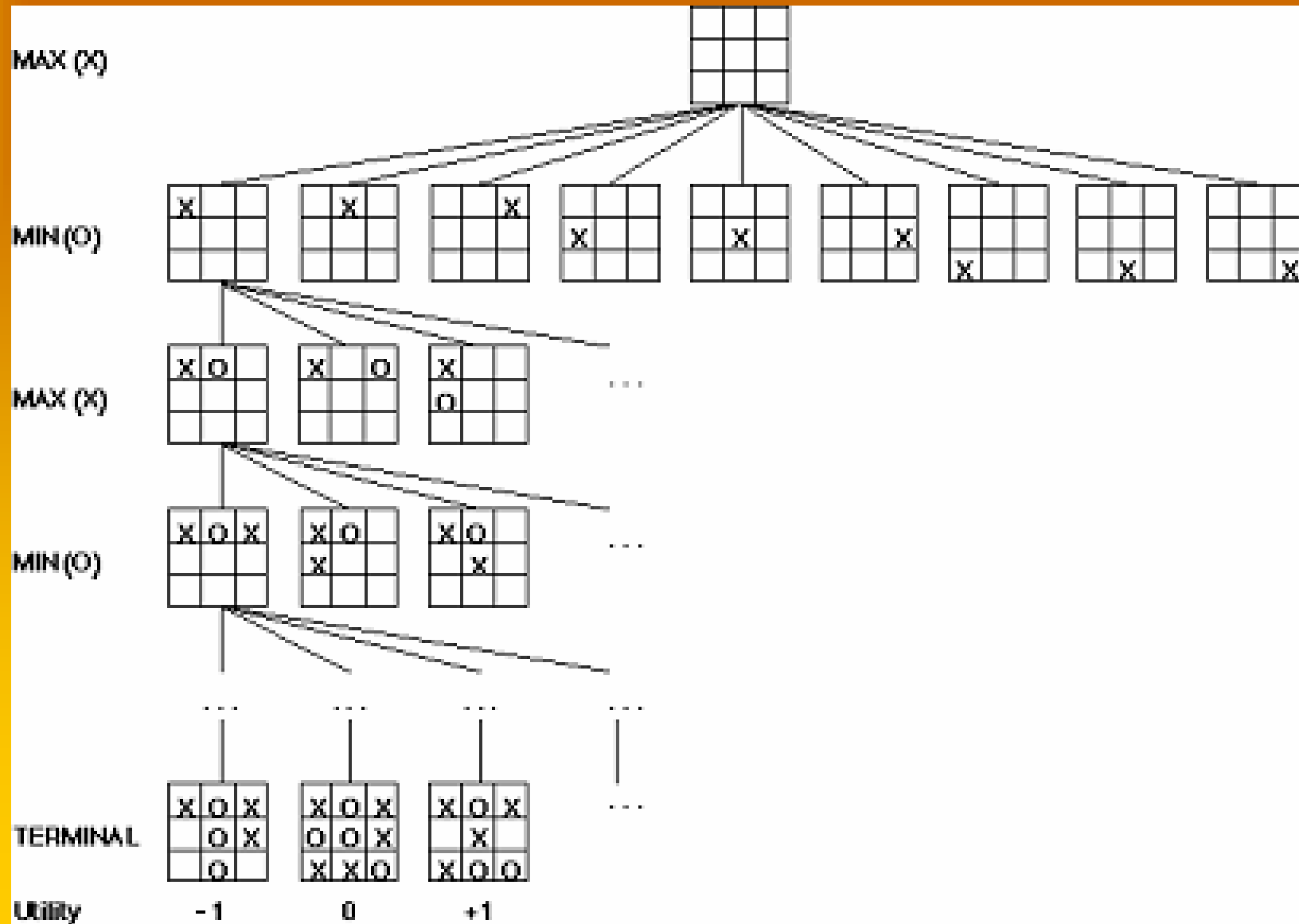
dimana 3-length adalah complete row, column, atau diagonal yang terisi

- Alan Turing's function untuk catur

– $f(n) = w(n)/b(n)$ dimana $w(n)$ = jumlah point value bidak putih and $b(n)$ = jumlah point value dari bidak hitam

- Deep Blue (yang mengalahkan Gary Kasparov tahun 1997) mempunyai lebih dari 8000 features untuk evaluation function

Game tree



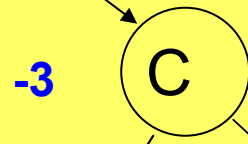
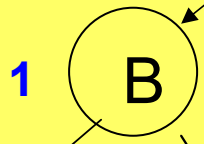
Minimax

- John von Neumann pada tahun 1944 menguraikan sebuah algoritma search pada game, dikenal dengan nama Minimax, yang memaksimalkan posisi pemain dan meminimalkan posisi lawan

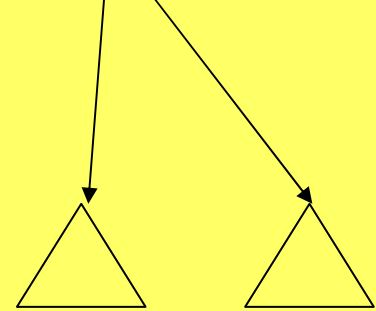
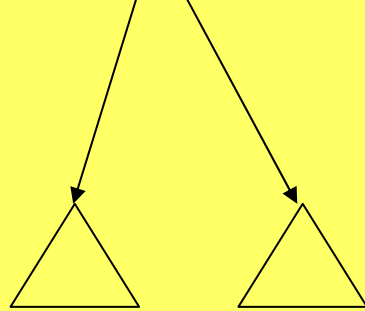
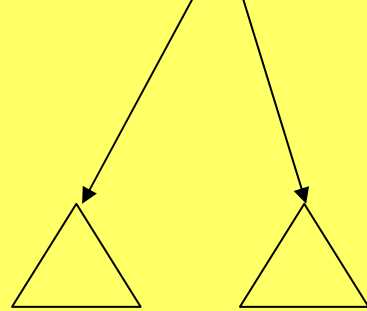
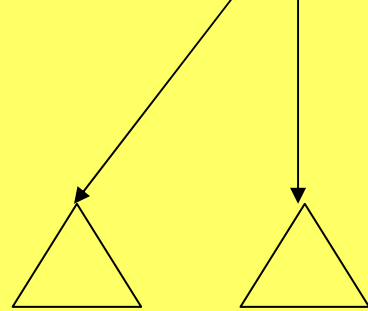
MAX



MIN



MAX



4

-5

-5

1

-7

2

-3

-8



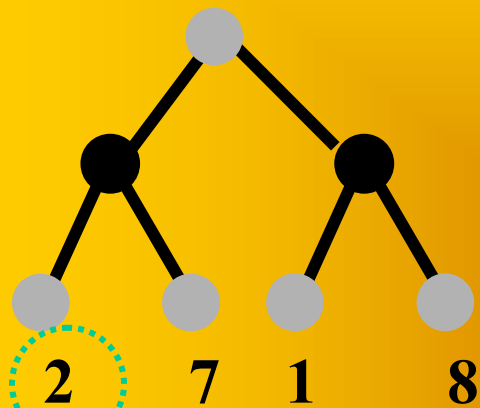
= terminal position



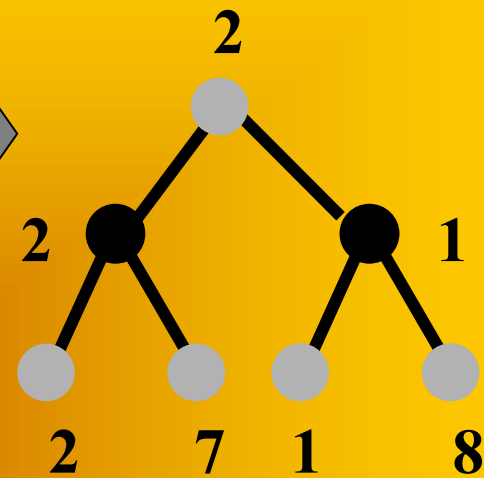
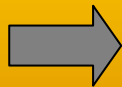
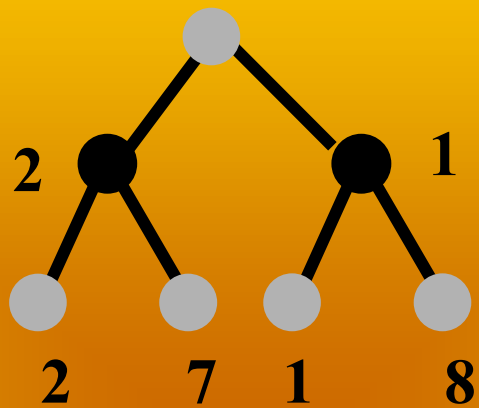
= agent



= opponent

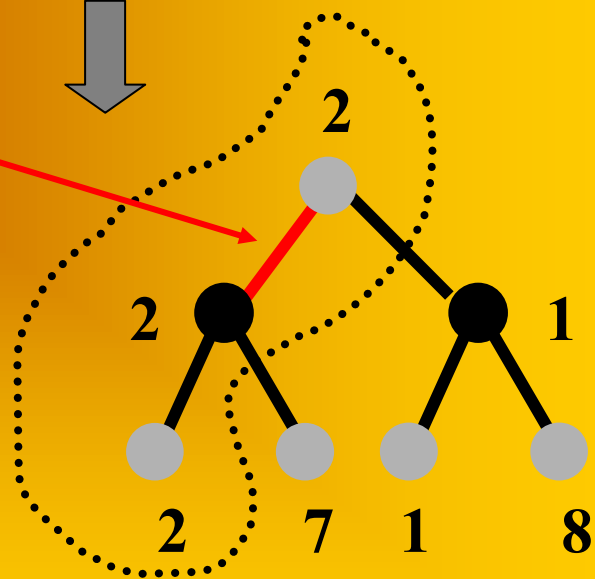


Static evaluator value



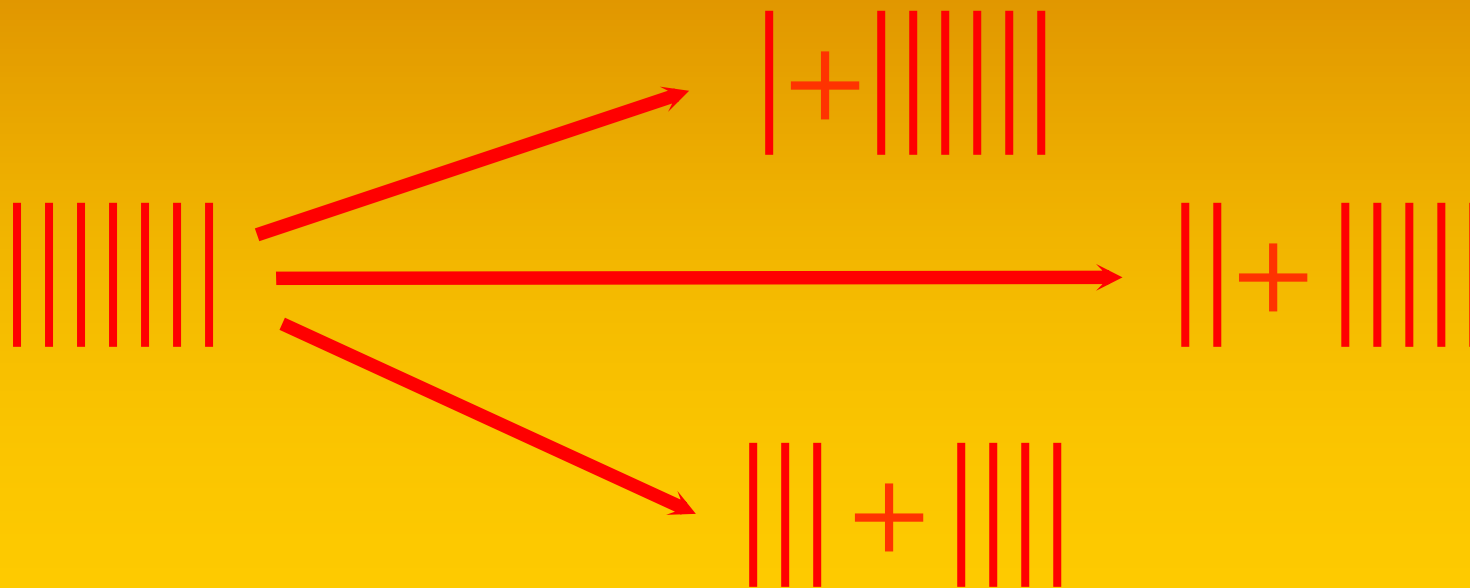
Jalan yang dipilih oleh Minimax

● MAX
● MIN

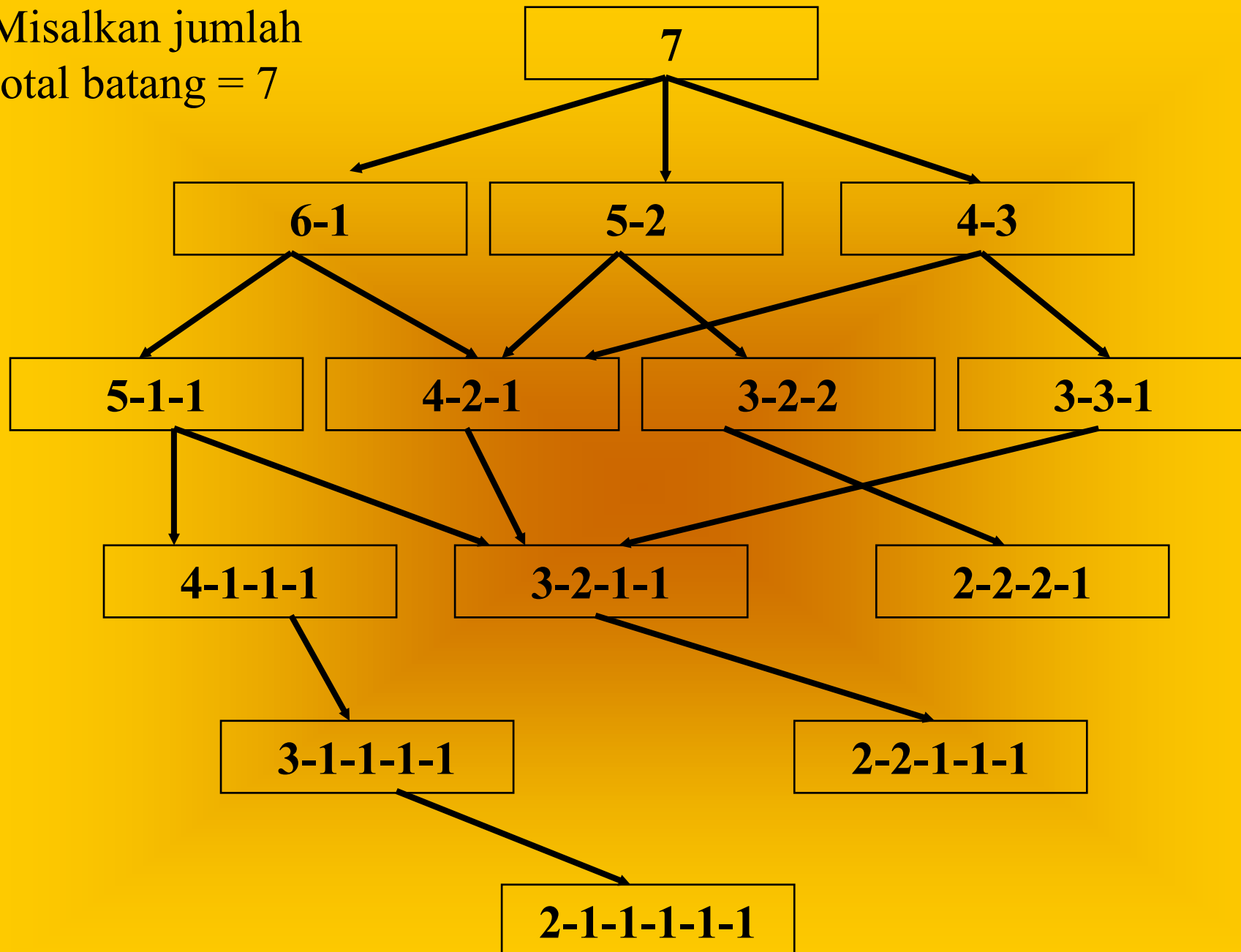


Contoh: Game Nim

- Diawali serangkaian batang
- Setiap pemain harus memecah serangkaian batang menjadi 2 kumpulan dimana jumlah batang di tiap kumpulan tidak boleh sama dan tidak boleh kosong

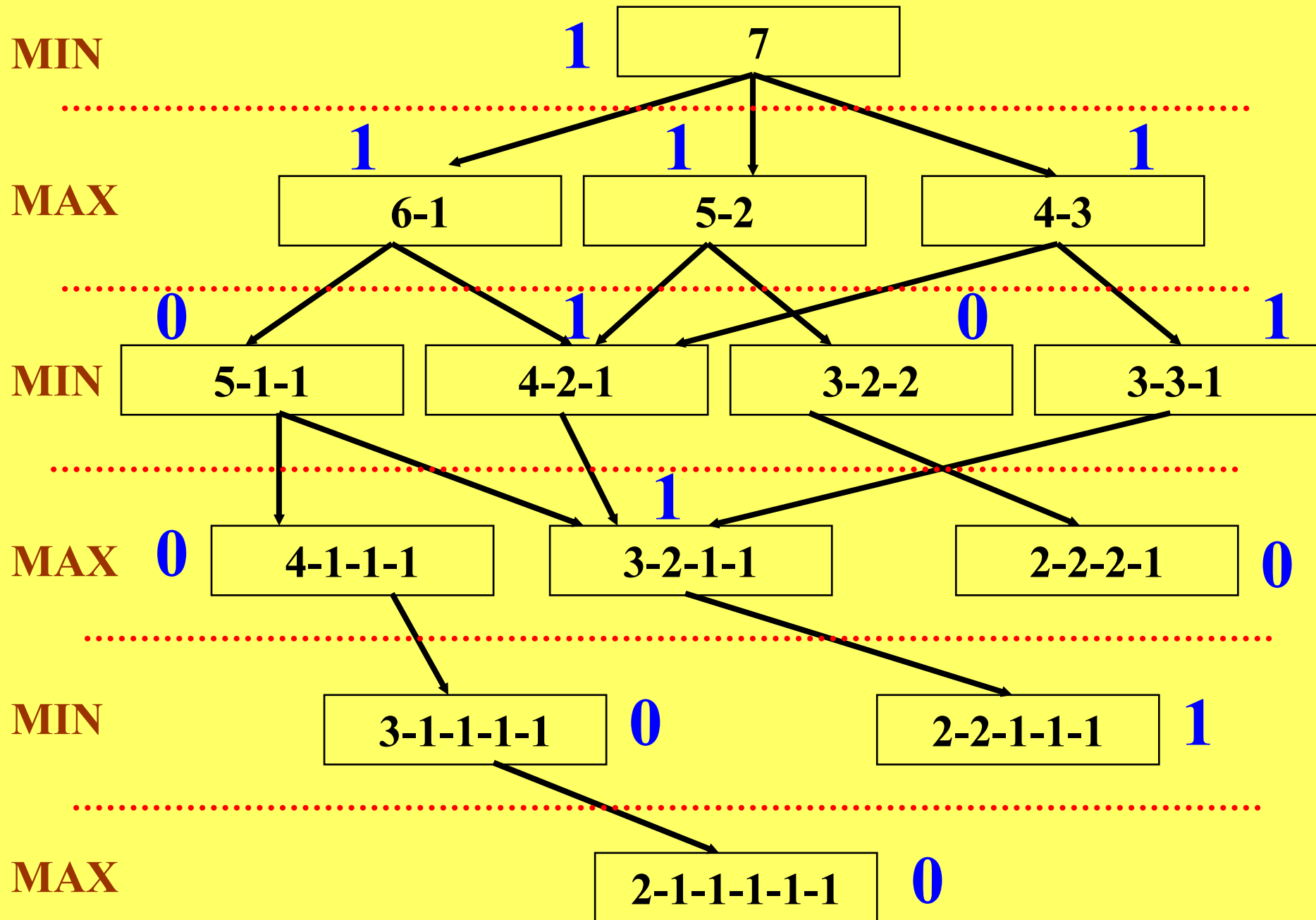


Misalkan jumlah total batang = 7



Asumsi

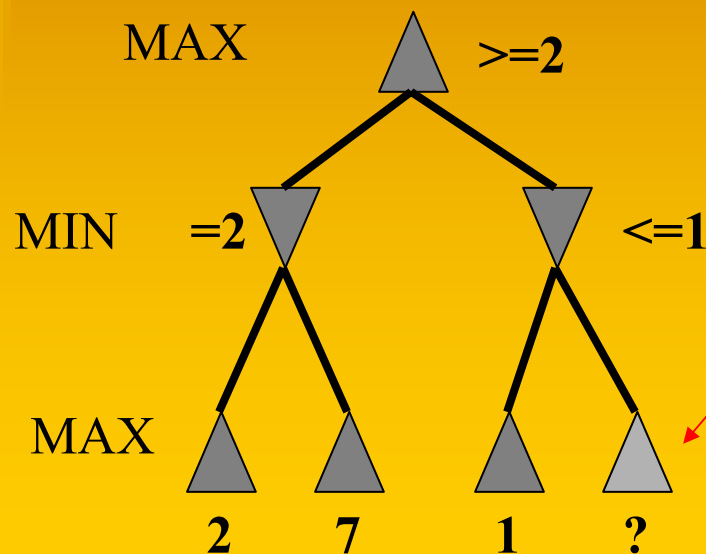
- MIN bermain dulu
- Evaluation function:
 - 0 \rightarrow MIN menang
 - 1 \rightarrow MAX menang



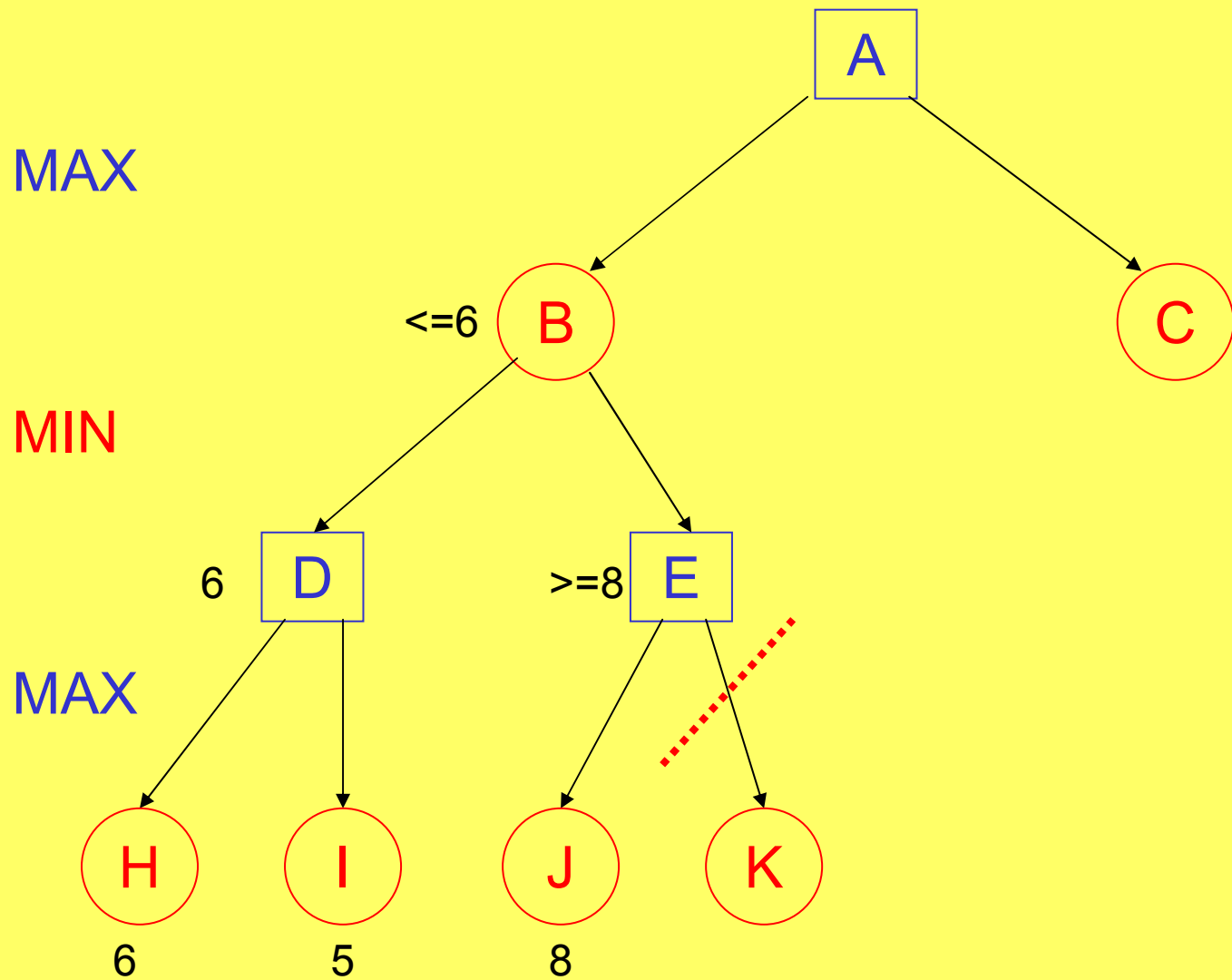
Alpha-beta pruning


- Merupakan improvisasi dari Minimax
- Basic idea


“If you have an idea that is surely bad, don't take the time to see how truly awful it is.” (Pat Winston)

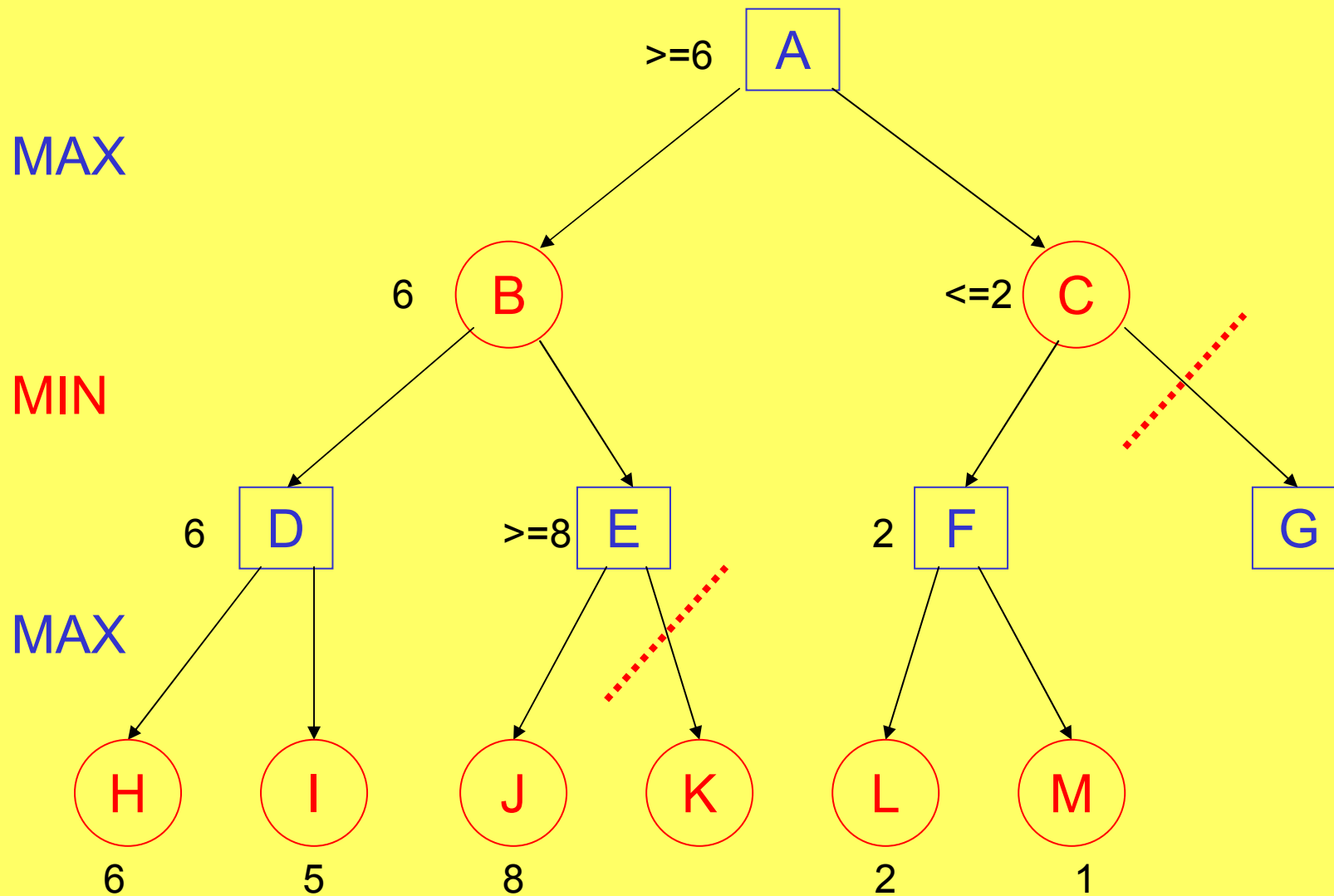


- Tidak perlu menghitung nilai pada node ini.
- Nilai pada node tersebut tidak akan berpengaruh pada root-nya.



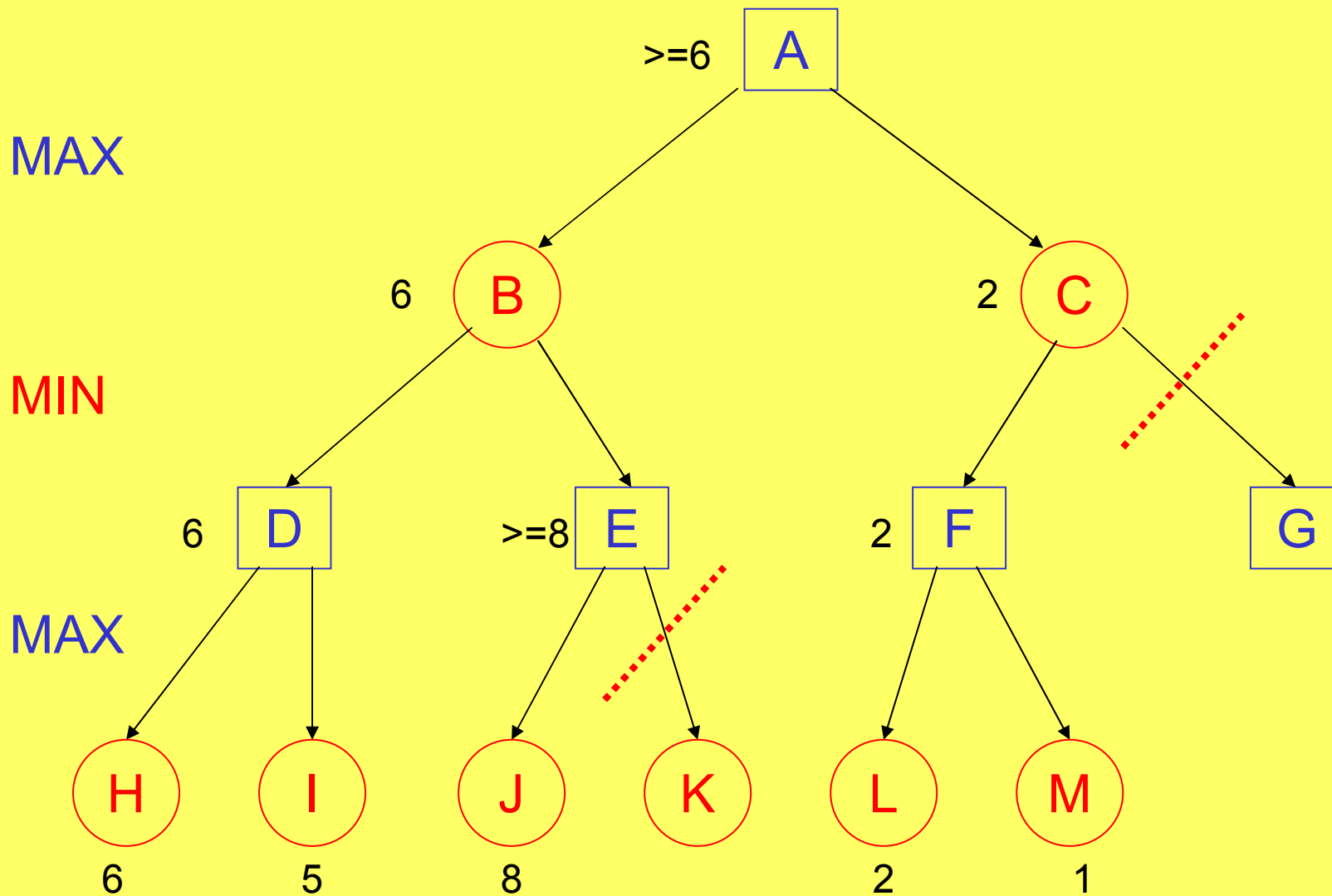
 = agent

 = opponent



□ = agent

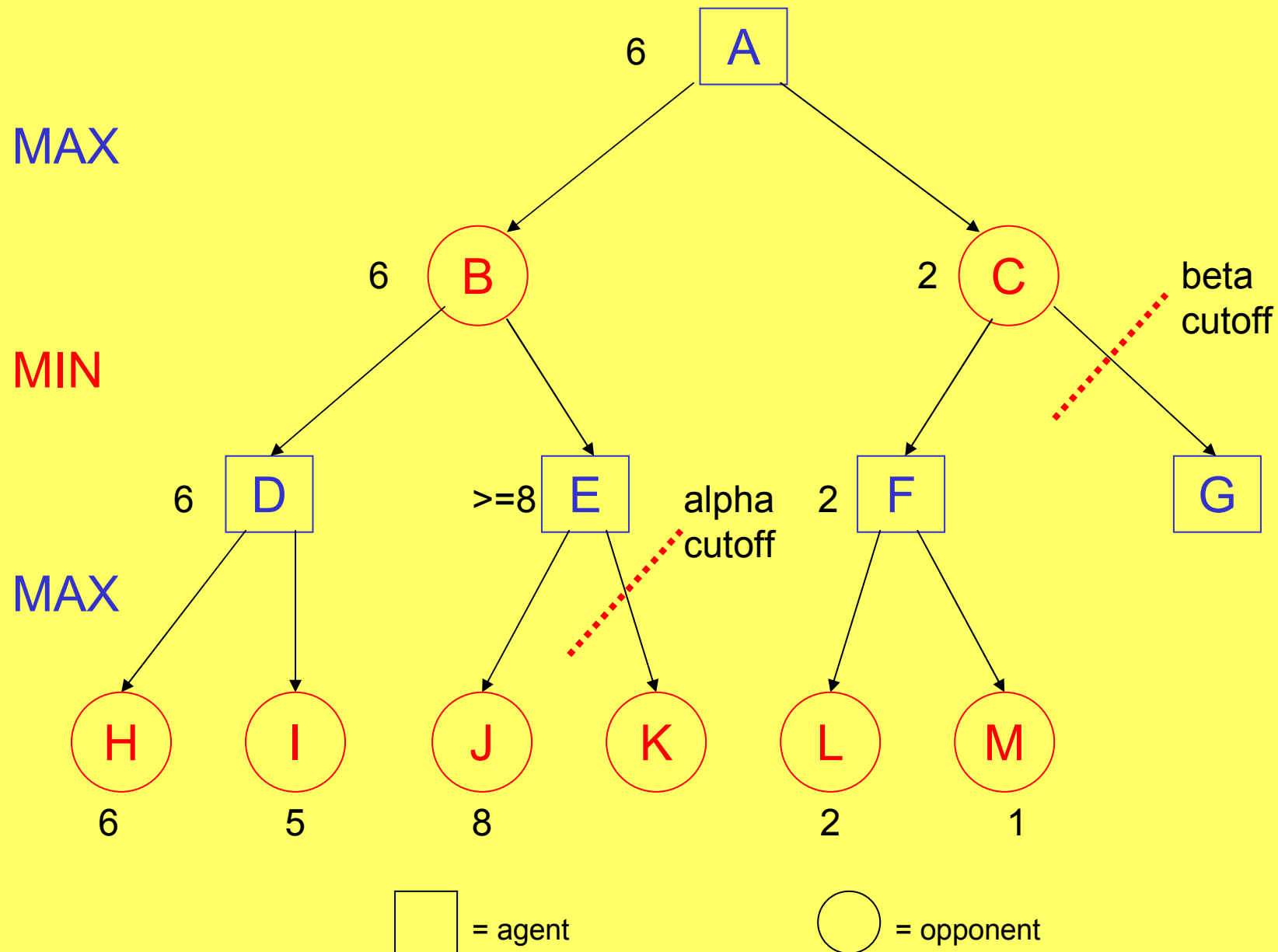
○ = opponent



= agent

= opponent

Alpha-beta Pruning



Referensi

- Notes by Charles R. Dyer, University of Wisconsin-Madison.
- Game Playing, Graham Kendall.
- Modul Ajar Kecerdasan Buatan, Entin Martiana, Tessy Badriyah, Riyanto Sigit, Politeknik Elektronika Negeri Surabaya, 2005.
- Artificial Intelligence (Teori dan Aplikasinya), Sri Kusumadewi, cetakan pertama, Penerbit Graha Ilmu, 2003.