0		
= CH.10: V	ictual Memory	
(devis	Main memory)	
Chevil	trad memory le significa de o partire Main memory o cità de e	
(1/6	الم العويث وفيد الع تعالم الهذا الدين الر	
	. الوال: المري أم شو السف مد إننا نطلّع معن البراج على على المعارين	
The same of the sa	€ حتى غير تعمل الذاكرة مأ فعل شكل عكم لعقام معاسماً	
10	of larged gam from (for) homogram women (MM)	
110	ack ground	
	فع أغاب الحالات ما بلزم يكوس البراج عيد موجود في العيوري عث الديم خيده،	
1001	العراض كويد الهجه موجود في الم تنفيذه عميد في نفس العمت ، سم تنفيذه عميده	
1	कर्मान्य अर्था अर्थ कर्म कर्म कर्म अर्थ क्र अर्थ	
1	عا في داي عب كالبرنام ويوف ملة سراليوري و يفل البرنام يرخاديه	
1 T-108	Ali bros Comisto actification of the state o	
-	Advantages of execute partially-loaded program:	
**	1) Program not constrained by limits of physical memory.	
	@ Each program takes less memory while running	
	3 Increased CPU utilization and throughput.	
	4 (ess I/o needed to load of swap programs into memory	
	1 Cos Traces in long or sample of the memoly	
₩ V	listud memory	
CER	istual Memory: separation of user lagical memory from	
	physical memory	
cen	العفليس ما معالبنام الا فتراهنية التي العالم تخرع وما مت المعلية التي	
	يفيهم الحماز عن تحيل وت عيل البرام.	
	only part of the program needs to be in memory to execu	tion
	logical address space > physical address space.	7077
.	Allows address space to be shared by several processes.	
	Allows for more efficient process creation.	
	Mole programs running concurrently.	
	Less I/O needed to load of swap process.	

the second secon
. Virtual Address space: logical view of how process is stored
In memoly.
الم احدًا كا متراجية تبقتر إنه العوام الا مترامي سال سمون ، ولم مامة
البراع مت و ابرا عقاما خ الما على من من المراج معتمد و البراع
عب موتوفر اس معوري سامة فالمنه البرس
* MMU (Memory Management Unit) must map logical to physical
الذاكرة الافتراجنية بعطي استغم جورة بأسالبرناج تم تحيلت بالكامل على الذاكرة ظلا
المعالجة وإنه مني مكل سفل بيناخ الواقع المناع محوّا إلى أجزاء وكالمم
عَلَى الرياع عن ممتم معالحت متم قبل معنى الأخذاء من والمعان الأخر متم وجمعه
. Backing State hat Hard Diskil de and
ع دظام الت غيل داياً بعث عبرالا في العنى م تفرية في المهوى من خيراعلى
الهارد دراء عاميتج مامه الكير خ تشفيرياع كانية
· Virtual memory can be implemented via:
1 Demand paging of land to make a margar to
@ Demand Segmantation, and sold and
. and and all to my among above to
* Virtual Address space
placemental emorphing gave to bod' of behavior of the seas D
Adress space) pliet uju parell'in Stack
وما نعتام ينه لذاكرة معليه
. System libraries shared via mapping
into virtual address space.
. Shaled memoly by mapping pages
read-write into virtual address space heap
· pages can be shaled during for(KC) data
speeding process creation code
Specific before at boundered at several the several to the several
The state of the s
The state of the s

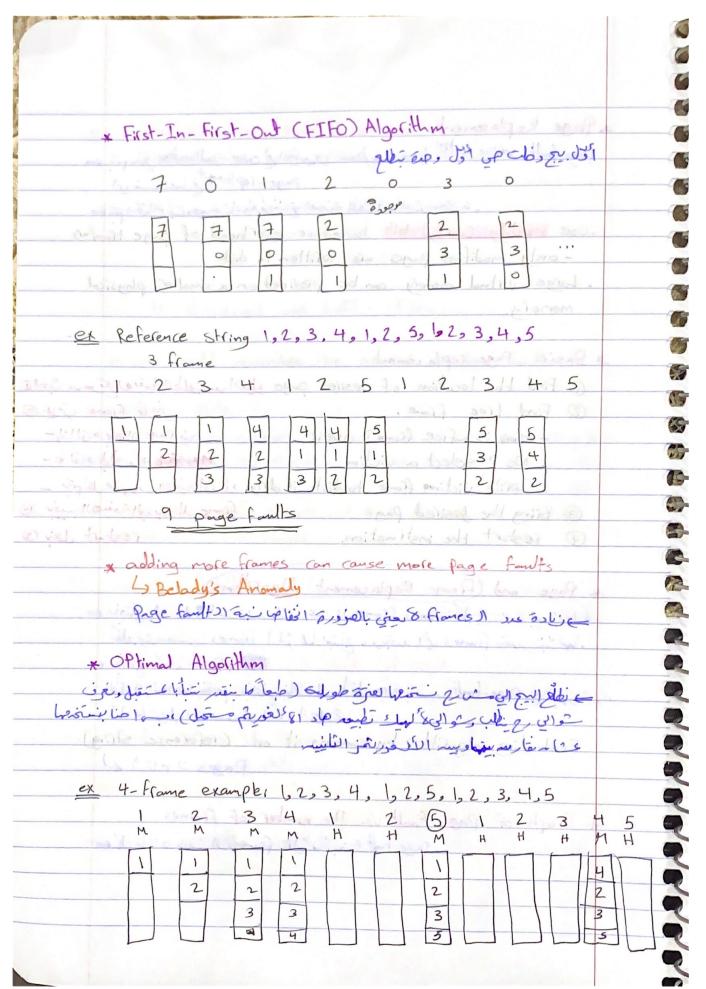
0	
2	
-	
-	* Demand Paging
	. Bling a page into memory only when it is needed
7	ے طبی ایا گیرے افغال بکیر مدر منا بیب البرنام کامل علی الذا کرف مناسم تحیل جمع
7	العفوات، بي مين العقات الى تنظلب مدالها دورياء.
7	bless I/o needed
7	La less memory needed
7	Le Faster response (lé 1 - beal mais).
7	La mole usels
7	Lazy supper : never swaps a page into memory inless page
	will be needed.
7	Cubillis & aserelling place
7	. swapper that deals with pages is a pager.
7)	many of your or the second total second
7	* Basic Concepts
7	عا المعود عب جعار لذا كرة أوّل مرة ، بحاول منه العوار - الى م حد
-	ريعنها قبل ما يرضعها كما به عرة على الهاردد المع.
7	. If pages needed are already memory resident
49	- No difference from non demand paging (hole bile) espective
1	If Dages needed and not memory resident
40	> Need to detect and load men page into memory from storage
0	
(6)	* Valid - Invalid Bit
(6)	V: in memory V/illaid the air page table of
0	i not in memoly
160	= out the 2 2/1/ oil Lal of the series
((Dage fault) cycage of land of the life
0	(about places) with lype zo a co
9	The fill of the second
	steam in Handling Page Fault
9	[(النظام اها من بعن عني أو معموه من موجودة بالدا كرة النظام اها من من موجودة بالداكرة النظام الما كرة الم
	OS Vina case Tal he were togo form
	عالم الله عليها الله
	أر موجودة ب س المعاري.
6	

	scheduled dist I reprie for force like shire tiente
	O looks at another table to decide if its invalid.
	reference or just not in memory
	@ Find free frame. babase of sold
	3 Swap page into frame via scheduled disk
	operation. Commented and appropriate of several sector of
	a set Validation bit to V.
	3 Pestart the instruction that caused the page fault
	* Aspects of Demand Paging
	. be a si song the dock that oggove.
	Extreme case-start process with no pages in memor
	2017 Dags (i (a .) - 1 dia) 1 (Gi) & Salight (dags
_	to the solution of the solutio
	عالى حالة خاص و يا نه كالبرنام يكر مثر من م يكر في و كا موقة و كالموقة و كا موقة و كالموقة و كا
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pule Den	page table with validation bit Secondary momory Tree-France List Lip Jie - Start (restart plan Mind & Jake) ILL Affection Cestart plan Mind & Jake ILL Affection Cestart pl
pule Don	page fallocipe cap the air of the street of
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	Stages in Pernand Paging
	O Trap to the OS.
	a shill a contract of overes state
	O Soule the user registers & process state.
	3 Determine that the interrupt was a page fault.
	A check the page reference was regal and
	determine the location
10	DIssue a read from the disk to a free frame:
	@ soit in a que until the read request is serviced.
	6 wait for the device seek / latency time
	6 shile waiting, allocate the CPU to some other user
	D'reclave an interrupt from I/O
	@ save the registers and process state for the other user.
	@ Determine that the intellight was from the disk
	@ correct page tables
	@ wait for the CPV to be allocated to this process
	@ Rest-re registers, process state, new page table
	then resume the interrupted instruction.
	x Performance of Demand Paging
	Three major dectivities bries this has begin
	1) service the interret
	@ Read the page to dis and of later of
	3 Restost the process
W	
(A)	page Fault Rate 0 < P < 1.01
	O a (page faults)
	p=1 (every reference is a fault)
	A count Time
	EAT = (1-P) x monoly access + p (Page foult overhead + swar Page out
	no page fault + swap page in + (estait overhead)
100	

Memoly access time = 200 ms Average page fault service time = 8 ms FAT = (1-P) x 200 + P (8 msec) = (1-P)200 + P(8=x10) = 200 + 7 999 800 P1 P=0.001 => EAT = 8200 ng * we should minimise the number of page faults. * Copy-on-write هلى التقنية بعد مريا عيد الاشتراك في من العمق عد بدور ما على سنة لل واحد فيم لحد ما يحاول واحد فيم بعيدل على السخة ، مَهَا بنقله سخة حامية (QW allows both parent and child processes to intially shale He same pages in memory. · VFock() Valiation on Fock() system call has parent suspend and child using copy-on-white addless space > Designed to have child call exects -> Very efficient * What happens if There is no Free Frames? as sayset a page replace position of all of Page replacement: find some page in memory, but not really in use, page it out. عليه احتيار الا تعوريثم بتعمر على اقل ألخوريثم ع والمعاعوم عو اي سنزره

*	Page Replacement (OII)
-	page-fault service conti les nepre espont e over-allocation en pri
	page - (eplainst & british of
	عبيم عدام ب معسما منعرف ني العنة العدلة مداك محدلة.
	. Use modify (dirty) bit to reduce overhead of page transfers
	- only modified pages are written to disk
	. Large virtual menory can be provided on a smaller physical
	meroly.
	2 place the 1900, 40, 10, 5, 40, 50, 40, 50
K	Basic Page replacement
	O Find the location of desiled page show when a seal of some C
	Trind free frame: crob frame of
	- No? select a victim - write victim frame to disk if dirty state of state of the pri
	^
	(4) sestart the instruction.
	* Page and (Frame Replacement Algorithms)
	a vising le FRAS I place frances) se vie vie FRAS I place
	. Ly in jai flames () e vise () frames () J. Homes () J.
	PRSI LL ZIEVE
	page-foult in apole de the prince pre La lais a l'el
,	اكول ما تومل البروس أو انتناء العليدة
	Evaluating adaptithm by running it on (reference string)
	Pages JI pto 1 e
	ca + France examples (2.3.4, 1.5.12, 3.4.5
4 1	* Graph of Page fault Vs. The number of frames
1 1	. Page fault) an der frames) us stile de
1 1 1	
	2 2 2 2 1
111	



Page-full = 6 page fulls Noted for measuring how well your algorithm performs. * least Recently Used (LRU) Algorithm) (Liether, 151) phist then by light of an analytic extensive of the performance o			
Page-full - 6 page fully Need for measuring how well your algorithm performs. * least Recontly Used (LRW) Algorithm) (Lietae, 15:1) plicist Leady Whe of a well things EX H-frame example: 1, 2, 3, 4, 1, 2, 5, 1, 2, 3, 4, 5 1 2 3 4 Better than FIFO 1 2 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	3		
Properfault = 6 page faults Used for measuring how well your algorithm performs. * least Recordly Used (LRU) Algorithm) ("Lietan, Jo") plicat leads; where or assolidation are limited and the suffer than FIFO 1 2 3 4 Better than FIFO 1 2 3 4 Better than FIFO 1 2 2 2 2 3 3 3 4 1 5 1 2 5 1 2 3 4 5 1 2 5 4 74 3 3 3 Prage faults = 8 page faults 1 1 2 3 3 3 Prage faults = 8 page faults 1 1 2 3 3 3 1 2 5 4 74 1 3 3 3 Prage faults = 8 page faults 1 1 2 2 2 2 2 2 3 4 5 1 2 5 4 74 2 75 6 10 10 10 10 10 10 10 10 10 10 10 10 10	-		
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(Mistage (15)) plicate Lands Why of a soulding a land of the suffer from Belady's onomaly. 1 2 3 4 Better than FIFO 1 2 3 4 Better than FIFO 1 2 2 2 2 2 3 4 5 1 2 5 1 2 3 4 5 1 2 5 1 2 3 4 5 1 2 5 1 2 3 4 5 1 2 5 1 2 3 4 5 1 2 5 1 3 3 3 3 1 2 5 1 2 3 4 5 1 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	7	* Least Recently Used (LRU) Algorithm)	
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		week of the second	

	@ Stack Implementation that any a aller your
	معنظ الما تعام العمال على العقوة الأقدم بيكور فت الما الأحدث
	+ يخلط تكور مؤسر العني لما تخدم جهن نظامها و الأعلى مؤم
	على الطرية رجة بي معد بيما الويتر بتغيران كل مره
	* LRU Approximation algorithm
	"Lino (8 &1 a see) clp clp clp to be de In reference ailoign of
	كوروز ما تعالى الله على إذا م الله عن العادة الحك مديراً العادة الحك مديراً العادة الحك مديراً العادة العادة عن العادة عن العادة عن العادة العادة عن العادة عن العادة العادة عن العادة
	* Second-chance algorithm
	reference bit it would FIFOUN The chim any bishop
	الم الحور المعارب على العاد عنى الله العاد ، بتم تبديلها دا كا يتم المتمام على
	1001
	sep cil 131, reference 1 colin would app tis olbi) 16
3	· Reference bit = 0 > replace it
	· Reference bit -1 > set to a
1	. Reference bit = 1 => set to 0 and leave page in memory
3	* Enhanced second-chance Algorithm
17	modify 1) is all all all all all all all all all al
18	=) (reference, modify)
	(0,0) reither recently used not modified (-it light)
	not recently used but madition (in (
	The state of the s
دو سياني .	(Is 1) recently used & modified (Juil his is is)
	* Counting Algorithms I don't ast.
	aselola de ser se una ser la
	Cleast trequently Used (LTU) Algorithms 1900
	keplace page with smallest count.
	(2) Most Frequently Used (MIFU) Algorithm,
	and has yet to be used.
	30.

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-	* Page-Buffering Algorithms
-	الله علم تحواله لازم دايد كوس في عصمه) فا منس (يعني ما ينزيقوا س ومت
	(mage) . I all singly a sale land
-	Tap a modified pages) + to late end piso 15. 6 seles
-	عبل ما يطلعوها لازع كاعتوا إدا م لتخداما كالم عرف بيوروا على طحمه
	1) keep a pool of free fromes, always, Tail
7	a teer list of modified pages.
0	3 keep free frame contents intact and note what is
-	in then.
7	* Applications and page replacement
7	- 15: 10 is red Page (epacend) of the polo les to the think I get
-	i will it as an all and it is a second with the
	Raw disk mode: Os can give direct access to the disk,
-	getting out of the applications.
	> By passes buffeling
	Jocking
	* Allocation of Frames
	The seed win mun number of frames.
	* Maximum number - total frames in the system.
	. Two major allocation schemes
-	Grixed Allocation
	priority Allocation
	pride and
	* Fixed Allocation
	is el jues of the placessess) se de frances) us preis plias.
	20 Augio to pracess de 5 Processes 100 frames
	* Proportional Allocation (Joseph Le de Stigen)
	Dynamic as degree of multipagramming, process size change
	Dynamic as degles of Sixm
	a; = allocation for P: = SI xm
0	Si = size of processif
	S= ZSi m= total number of Games
	M = Loter

*Global Vs. Local Allocation TP of 1 pade of no frame ist in a pul Global Il + مالها سي على الأش بأثر على وعت التنييذ مع عبال (8 تاجية 1 8 local Mes of Est of the flower of the gold ocal state عك بازى لا مقال عر جدالنا كرة. * Redaining Pages * Non-Uniform Memory Access (NUMA) (. speed of access to memory varies, optimal performance > "Close to" CPU o solved by soldies by creating Igroups العالمي يوقبوا علاقة اله ١٠٠٠ باطعوري وهاذا * Thrashing If process doesn't have enough pages, the page fault rate is very high. proges >1) Thrashing: A process is busy suapping pages in and out Pages I My with with while coal as no when I size of locality 7 total mamory size

