99 Ways to Crash

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A Few Words about the Speaker

• Nectar Daloglou; Progress & QAD since 2000.
• Performed specialized services at more than 70 Progress customer sites:
  • Progress Database Administration
  • Install/Upgrades/Migrations of Progress and QAD Applications
  • Technical Audits / Performance Tuning
  • Business Continuity Strategies
99 Ways to CRASH!

• Don’t try this at home!
• Learn from mistakes of others
• Goal: Show you a crash you can prevent
• Crash: DB ceases to respond
• Why 99?
Agenda

• The “Human” Factor
• Database Management
• Operating System
• Beyond our control
• Questions
Human Error

**Human error** means that something has been done that was "not intended by the actor; not desired by a set of rules or an external observer; or that led the task or system outside its acceptable limits". **In short, it is a deviation from intention, expectation or desirability.**

Source: https://en.wikipedia.org/wiki/Human_error
The Human Condition

Human Error

Skill-based errors

Mistakes

Slips of action

Lapses of memory

Rule-based mistakes

Knowledge-based mistakes

Accidental File Delete

• Delete .d’s (and .db, .d1, etc....whoops!):
  – `rm *.d*`

• Delete development environment
  – `rm -rf /dev*`

• Unintentional file redirect
  – `> _mprosrv db`
Accidental rm

- Use *root* or privileged user only when necessary
- List the files first

- `ls filetodelete*`
- `pwd`
  `/db/prod`

- Extra caution with root or privileged user
Accidental Server Shutdown

- Fat thumb:
Accidental Server Shutdown

• Communication breakdown between teams
  – “Unplanned” planned outage
  – Server decommission
• Point and click VM shut down
Monitor your servers’ upstatus

- Use monitoring tool or scripts to poll server status and alert/page you (From another server!)
Proshut User Disconnect

- Disconnect a user safely

```
[qaddba@protodev:/data/eb21/db]
$ proshut mfgdemo
usr  pid  time of login  user id  tty          Limbo?
 5   13497 Thu Jun 23 19:41:22  2016  APW  /dev/pts/1      no
 6   13500 Thu Jun 23 19:41:22  2016  BIW  /dev/pts/1      no
 7   13503 Thu Jun 23 19:41:22  2016  WDOG /dev/pts/1      no
 8   13741 Thu Jun 23 19:41:46  2016  nectar /dev/pts/2     no

1  Disconnect a User
2  Unconditional Shutdown
3  Emergency Shutdown (Kill All)
x  Exit

Enter choice> 1
```
Avoid Being Prone to Human Error

- Uh-oh!
Avoid Being Prone to Human Error

1. Remove the “2” key:

![Keyboard Image]

2. Or Use:

```
_mproshut db –C list
_mproshut db –C disconnect userid
```
Agenda

• The “Human” Factor
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• Operating System
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Abnormal Shutdown

• Terminating a shared memory process holding latches will crash the database:

[2016/06/17@11:39:57.214-0400] P-241778   T-1   I WDOG    6: (2522)  User 22 died holding 1 shared memory locks.
[2016/06/17@11:39:57.214-0400] P-241778   T-1   I WDOG    22: (5029)  SYSTEM ERROR: Releasing multiplexed latch. latchId: 3096224748304416
[2016/06/17@11:39:57.347-0400] P-1134704  T-1   I BROKER   0: (2249)  Begin ABNORMAL shutdown code 2

• A UNIX kill command or Windows End Task
• An excellent read on safe kill’s & free kill script: “How do I kill thee”:
  http://download.psdn.com/media/exch_audio/2008/OPS/OPS-16_KOUFALIS.pdf
Abnormal Shutdown

- Killing an agent from OpenEdge Management
Abnormal Shutdown

- Closing a shared-memory window or logging off from Windows
Windows Log off

• Logging off / Signing out from Windows will effectively terminate all your Progress running processes:
  – Example: _mprosrv; replserver; prowin32, etc..

• Use OpenEdge Explorer, dbman, or Task Scheduler to run server processes in background
Excessive BI Growth

**Oops! No -bistall or -bithold:**

- [2014/08/14@16:05:03.105+0200] P-2300 T-4592 I ABL 8: (10601) SYSTEM ERROR: Attempted to exceed maximum size on file \prod\prod.b2.
- [2014/08/14@16:05:03.120+0200] P-2300 T-4592 F ABL 8: **(854)** Insufficient disk space to extend the before-image file.
- [2014/08/14@16:05:03.167+0200] P-3360 T-604 I SRV 3: (2520) Stopped.
- [2014/08/14@16:05:03.214+0200] P-464 T-660 I SRV 2: (2520) Stopped.
- [2014/08/14@16:05:03.214+0200] P-2304 T-2312 I SRV 1: (2520) Stopped.
- [2014/08/14@16:05:03.245+0200] P-3320 T-776 I SRV 4: (2520) Stopped.
- [2014/08/14@16:05:04.261+0200] P-2300 T-4592 I ABL 8: (5028) SYSTEM ERROR: Releasing regular latch. latchId: 4
- [2014/08/14@16:05:04.261+0200] P-2300 T-4592 I ABL 8: (5028) SYSTEM ERROR: Releasing regular latch. latchId: 1
- [2014/08/14@16:05:04.433+0200] P-736 T-2784 I ABL 9: (453) Logout by batch on CON:.
- [2014/08/14@16:05:04.511+0200] P-2496 T-2500 I BROKER 0: (2249) Begin ABNORMAL shutdown code 2
- [2014/08/14@16:06:05.511+0200] P-2496 T-2500 I BROKER 0: (2251) Destroyed user 10 pid 3236.
- [2014/08/14@16:06:06.511+0200] P-2496 T-2500 I BROKER 0: (2527) Disconnecting dead user 10.
- [2014/08/14@16:06:08.527+0200] P-2496 T-2500 I BROKER : (334) Multi-user session end.
Excessive BI Growth

- **Possible Causes:**
  - Largely scoped transactions
  - Long running transactions
  - Bad Code

- **Consider:**
  - `-bistall -bithold`
  - Monitor long transactions and BI size

- **90% Warning in .lg not always enough notice:**

  [2015/02/25@12:57:10.468+0800] P-7475 T-140691071489824 I ABL 55: (9240) BI File size has grown to within 90 percent of the threshold value of 2.0 GBytes.

  [2015/02/25@13:04:21.953+0800] P-21931 T-139708899522336 I ABL 58: (9239) BI File Threshold size of 2.0 GBytes has been reached.

Monitor BI Usage
Cannot Switch to Empty AI Extents

- Again no stall (-aistall)

[2008/03/04@18:39:35.796-0500] P-868468 T-1 I Usr 46: (3773) Can't switch to after-image extent /reg04/dbs/ai/qadprd04.ai it is full.
[2008/03/04@18:39:35.799-0500] P-913610 T-1 I FMAGENT11: (453) Logout by DB_Agent on /dev/pts/50.
[2008/03/04@18:39:35.803-0500] P-868468 T-1 I Usr 46: (5350) Database Server shutting down as a result of after-image extent switch failure.
[2008/03/04@18:39:35.826-0500] P-3633292 T-1 I RPLS 5: (10672) The Source database is crashing. Fathom Replication cannot continue.
Cannot Switch to Empty AI Extents

- Possible Causes:
  - AI management script or AIMGMT process not running
  - Out of disk space
  - OE Replication: Not synced to target DB(s); AI files “Locked”

- Consider:
  - -aistall
  - Use AIMGMT utility
  - Monitor empty extents and AI archive disk space
ProTop AI Alert
OE Replication: Stall by Full – pica queue

- Communication queue between the RDBMS and the replication server
- Full queue causes a performance stall
- Restarting the replication server will flush queue
- Monitor using Promon:
  - R&D>1>16

10/18/08 Status: Database Service Manager
00:20:44
Communication Area Size : 1000000.00 KB
  Total Message Entries : 9142822
  Free Message Entries : 914
  Used Message Entries : 9141908
  Service Latch Holder : -1

- Or get alerted by ProTop

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Calculating -pica

-pica = (Total AI Writes/Block count) * 1.25

Total AI writes can be determined with promon
   promon → R&D → Option 2 (Activity) → Option 6 (AI Log)

*Note: Gather Total AI writes at the busiest update portion of the day

Block count in version 10+ = 9.16

When in doubt set it larger (memory is cheap)
Maximum value for -pica

256 (9.1E, 10.0B, 10.1A),
1024 (9.1E04),
512 (10.0B05),
8192 (10.1A02, 10.1B01),
1000000 (10.2B08, 11.2+)
2GB File Limit

• Large Files Not Enabled:

[2008/11/26@05:58:42.846-0500] P-2510996 T-1 I Usr 6: (10601) SYSTEM

[2008/11/26@05:58:42.874-0500] P-2510996 T-1 F Usr 6: (8897) SYSTEM ERROR: Unable to extend
database within area HISTORY.

[2008/11/26@05:58:43.710-0500] P-2510996 T-1 I Usr 6: (2252) Begin transaction backout.

[2008/11/26@05:58:43.710-0500] P-2510996 T-1 F Usr 6: (2255) SYSTEM ERROR: Incomplete
microtransaction.

[2008/11/26@05:58:43.711-0500] P-2510996 T-1 I Usr 6: (439) ** Save file named core for
analysis by Progress Software Corporation.

[2008/11/26@05:58:43.888-0500] P-2211938 T-1 I BROKER 0: (2249) Begin ABNORMAL shutdown code 2

Use: proutil <DB> -C EnableLargeFiles
No variable extent

• Similar issues when fixed extent fills up:

[2008/11/26@05:58:42.874-0500] P-2510996 T-1 F Usr 6: (8897) SYSTEM ERROR: Unable to extend database within area HISTORY.
[2008/11/26@05:58:43.710-0500] P-2510996 T-1 I Usr 6: (2252) Begin transaction backout.
[2008/11/26@05:58:43.710-0500] P-2510996 T-1 F Usr 6: (2255) SYSTEM ERROR: Incomplete microtransaction.
[2008/11/26@05:58:43.711-0500] P-2510996 T-1 I Usr 6: (439) ** Save file named core for analysis by Progress Software Corporation.
[2008/11/26@05:58:43.888-0500] P-2211938 T-1 I BROKER 0: (2249) Begin ABNORMAL shutdown code 2

• Ensure every area has a variable extent:

d "TRGLDET":27,64 ./db f 512000
d "TRGLDET":27,64 ./db
#
d "TRGLDET_IDX":28,32 ./db f 512000
d "TRGLDET_IDX":28,32 ./db
Infinite (-l) increases

• Process eventually consumed all the memory

    [2014/03/17@12:02:46.754-0400] P-8573096 increasing from 3323700 to 3323710.
    [2014/03/17@12:02:46.760-0400] P-8573096 increasing from 3323710 to 3323720.
    [2014/03/17@12:02:46.767-0400] P-8573096 increasing from 3323720 to 3323730.
    [2014/03/17@12:02:46.773-0400] P-8573096 increasing from 3323730 to 3323740.

    T-1  I ABL  140: (5408)  WARNING: -l exceeded. Automatically

• Monitor and consider -hardlimit
Lock Table Overflow (-L)

- Hitting the max will eventually consume all shared memory

Begin transaction backout. (2252)
Lock table overflow, increase -L on server (915)
Out of free shared memory. Use -Mxs to increase. (6495)
SYSTEM ERROR: mtlatch <latch-num>, holding <lock>. (3712)
SYSTEM ERROR: Releasing regular latch. latchId:<latch-num> (5028)
SYSTEM ERROR: Releasing multiplexed latch. latchId:<latch-num> (5029)
User <num> died holding <num> shared memory locks. (5026)

- Monitor open transactions and record lock counts

- Use: proutil db –C increaseto –Mxs #
Failed DB File Move

• `mv /db/prod.d1 /db1/prod.d1`
• `prostrct repair prod`
• Oops! What happened?

```
Error
Last open date mismatch. (9215)
Extent has a different last opened date Fri Jun 24 00:40:39 2010, (9213)
Control Area has a last open date of Fri Jun 24 00:41:08 2010. (9217)
Probable backup/restore error. (605)
Database is damaged, see documentation. (1486)
```

• Rename .db before and after, to prevent accidental logins

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No integrity (-i) crash

• Prepare to restore
Using proutil –F Forced Access

- Back up DB beforehand
- Should be used as a last resort
- Used to extract and salvage as much data as possible
- Use ASCII Dump/Load
Agenda

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Linux Out of Memory Killer

• A self-preservation mechanism that terminates a process when memory is over committed.

• OOM will kill the most memory consuming process

/var/log/messages:
Oct 22 16:05:48 s619784dc3vl42 kernel: Out of memory: Kill process 5995 (_mprosrv) score 421 or sacrifice child
Oct 22 16:05:48 s619784dc3vl42 kernel: Killed process 5995, UID 65535, (_mprosrv) total-vm:34767444kB, anon-rss:12680kB, file-rss:31617936kB

• Can control likelihood by setting oom_adj (Valid range -16 to +15; -17 to exempt):
  – Example: echo -17 /proc/5995/oom_adj
Host name Change

• A simple host name change:

```bash
> hostname slv8002
[2008/09/24 08:28:48.790-0400] P-10817782 T-1 I BROKER 0: (4192) /reg01/dbs/qaddb/qadprd01.lk:
HOSTNAME is slv8002, expected slv8000.
[2008/09/24 08:28:48.790-0400] P-10817782 T-1 I BROKER 0: (4196) /reg01/dbs/qaddb/qadprd01.lk is not a valid .lk file for this server.
```

• .lk file contains host

```bash
> cat qadprd01.lk
slv8000
```
Out of disk space

- Out of disk space
  [2016/05/04 00:31:35.563+0800] P-14609      T-139953801205536 I ABL    23: (9450)  bkioWrite:Insufficient disk space during write, fd 119, len 16384, offset 13520, file /reg12/dbs/ai/r12prd3.a1.
  [2016/05/04 00:31:35.563+0800] P-14609      T-139953801205536 I ABL    23: (4163) Insufficient disk space.

- Monitor disk space
- Track database growth rate
- Segregate DB files from application, home/work directories
- Do not store anything under / <root> or C:\
Unintended Java update

- A Linux Kernel patch updated java
  - Used to be: /usr/java/jdk1.5.0_22/
  - Now /usr/java/jdk1.6.0_10
  - Progress likes its java a certain way
Agenda

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Hardware Failure

SYSTEM ERROR: wrong dbkey in block. Found <dbkey1>, should be <dbkey2> (1124)
SYSTEM ERROR: read wrong dbkey at offset <offset> in file <file> found <dbkey>, expected <dbkey>, retrying. (1152)
SYSTEM ERROR: read wrong dbkey at offset <offset> in file <file> found <dbkey>, expected <dbkey>, retrying. (9445)
SYSTEM ERROR: Database block <nbr> has incorrect recid: <nbr>. (355)
SYSTEM ERROR: wrong dbkey (1067)
BROKER 0: rlrndxt: note prefix and suffix lengths don't match 8224 48
SYSTEM ERROR: The broker is exiting unexpectedly, beginning Abnormal Shutdown. (5292)

• Disk Subsystem
  – SAN Controller
  – RAID Controller
• CPU
• RAM
• Power Supply
• Motherboard
• UPS
• Network

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Other Disasters

- Natural Disaster/Extreme Weather
- Power outage
- Flood
- Fire
- Utility outage (Excluding Fire)
- Cyber attack
- Supply chain distribution
- Terrorist event
- Employee health and safety incident
- Epidemic/Pandemic
- Sabotage
- Environmental accident
- Others...
Version Specific: 10.2B/11.x on Red Hat 7.2 & 7.3

- Database crashes when its semaphores get removed
  
  (1075) Semaphore id -32767 was removed
  (6517) SYSTEM ERROR: Unexpected error return from semAdd -1
  
  (1132) Invalid semaphore id
  (10839) SYSTEM ERROR: Unable to set semaphore set : semid = 7, errno = 22.
  (-----) semLockLog_2: semValue val = -1

- Option A: Use system/root user
- Option B: Edit `/etc/systemd/logind.conf`, change `RemoveIPC=no`
- See Progress Kbase #000086484
Progress Bugs

• Database crash after Lock Table Overflow
  Lock table overflow, increase -L on server (915)
  Begin transaction backout. (2252)
  Transaction backout completed. (2253)
  SYSTEM ERROR: mtlatch <latch-num>, holding <lock>. (3712)
  SYSTEM ERROR: mtlatch 7, holding 0x40. (3712)
  ** Save file named core for analysis by Progress Software Corporation. (439)

• Truncate after Emergency Shutdown corrupts BI
  rmUndoLogicalChange: recid <RECID> area <Areanum> txn <Transnum> updctr <n>
  rmFetchRecord returns <n1> expected <n2>

• LKRELS Errors in 10.1B
  SYSTEM ERROR: lkrels record <recid> not locked. (435)
Stay current

- Stay current with your OpenEdge version:

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<th>Product Version &amp; Current Service Pack (SP)</th>
<th>Life Cycle by Product Release</th>
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BONUS!

• Ensure you have a valid backup
• Not valid if it’s not tested
Conclusion

• Human errors can be managed with some situational awareness and behavior change
• A good monitoring and alerting tool can help avoid outages
• Stay current and learn to avoid DB crashes
• Have an up-to-date disaster recovery plan (And good backup!)
Questions?
Questions

• Questions or comments? Feel free to e-mail me:

Nectar Daloglou: nd@wss.com
Thank You!
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