Batch Exit Codes

Question: My batch job exited with code ###. What does that mean?

When a program finishes executing it returns an exit code to the system. The batch system reports this exit code. There are three general ways for the exit code of a program to be set.

1) The program can explicitly call exit() (or return from main(), which eventually calls exit()). In this case the exit code is the argument to exit() and its meaning depends on the program. The call to exit() may actually occur in a library routine that your program uses. An example of this is the SGI FORTRAN io library. The FORTRAN io routines set an exit code in the range 100 - 185 when an error occurs. The specific meaning of these codes can be found in the appendix to the Fortran 77 Programmer's Guide (available online as an insight book).
2) The program executes the last instruction in main(), (not calling exit() or return). In this case the system sets the exit code to 0.
3) The program can terminate due to the receipt of a signal. In this case the system sets the exit code to 128 + <signal number>. (This assumes that the program doesn't have a signal handler which calls exit(), then we're back in case 1).
   The following table lists the various signals whose default action is to terminate a program. Note that the codes are different depending on the platform you run on (SGI Origins or IBM pSeries). See /usr/include/sys/signal.h for more info.

Name	Number (SGI)	Number (IBM)
SIGHUP	1	1
SIGINT	2	2
SIGQUIT	3	3
SIGILL	4	4
SIGTRAP	5	5
SIGABRT	6	6
SIGEMT	7	7
SIGFPE	8	8
SIGKILL	9	9
SIGBUS	10	10
SIGSEGV	11	11
SIGSYS	12	12
SIGPIPE	13	13
SIGALRM	14	14
SIGTERM	15	15
SIGUSR1	16	30
SIGUSR2	17	31
SIGPOLL	22	23
SIGIO	22	23
SIGVTALRM	28	34
SIGPROF	29	32
SIGXCPU	30	24
SIGXFSZ	31	25
SIGRTMIN	49	888
SIGRTMAX	64	999

There are several reasons that your program might receive a signal.
a) You sent it a signal with kill, bkill, or bdel. If you don't specify which signal to send, kill defaults to SIGTERM (exit code 143) and bkill defaults to SIGKILL (exit code 137). Bdel sends SIGINT (exit code 130), then SIGTERM, then SIGKILL until your job dies.
b) The system sent it a signal because an error occurred or a system resource limit was reached. In this case, in addition to the exit code, the batch system will usually report an error message. Examples of this case are:

Signal	Exit Code	Typical Reason
SIGILL	132	illegal instruction, binary probably corrupt
SIGTRAP	133	integer divide-by-zero
SIGFPE	136	floating point exception or integer overflow (these exceptions aren't generated unless special action is taken, see man sigfpe for more information)
SIGBUS	138	unaligned memory access (e.g. loading a word that is not aligned on a word boundary)
SIGSEGV	139	attempt to access a virtual address which is not in your address space
SIGXCPU	158/152	CPU time limit exceeded
SIGXFSZ	159/153	File size limit exceeded

c) The batch system sent it a signal because it exceeded a limit on the queue it was running in. Three queue limits are enforced in this way:

i) CPU limit. When the total CPU usage of all processes in a batch job exceeds the queue CPU limit, the batch system kills the job by sending SIGXCPU, then SIGINT, then SIGTERM, then SIGKILL until the job dies. In this case the exit message says "Exited with signal termination: Cputime limit exceeded, and core dumped."

Under rare circumstances, the system (as opposed to the batch system) could kill a job by sending SIGXCPU. In this case the exit message would say "Exited with exit code 158."

ii) RUNTIME limit. Most batch queues have a limit on the actual time that a job can run. When this limit is exceeded, the batch system kills the job by sending SIGUSR2, then SIGINT, then SIGTERM, then SIGKILL until the job dies. Usually the SIGUSR2 kills the job and the exit message says
"Exited with exit code 145." on the SGI systems
"Exited with exit code 159." on the IBM systems

(Since the batch system is killing the job, one could argue that it is a bug not to give a more informative message.)

A third queue limit, the STACKSIZE limit, is enforced by the system (rather than the batch system) killing the job by sending a SIGSEGV. The exit message says "Exited with exit code 139."