

Usando GameMaker

GameMaker Ã un programma facile da usare per la creazione dei tuoi giochi per computer. Questa sezione del file d'aiuto ti da' tutte le informazioni che ti servono per la creazione del tuo primo gioco. Le sezioni successive discuteranno degli argomenti piÃ¹ avanzati, come migligliorare e distribuire il tuo gioco, e il linguaggio di programmazione incorporato GML che considerevolmente estende le possibilitÃ .

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Quindi vuoi creare il tuo gioco per computer

Giocare i giochi per computer è divertente. Ma di solito è più divertente disegnare i tuoi giochi per computer e permettere ad altre persone di giocarli. In passato, la creazione di giochi per computer non era facile. I giochi commerciali per computer che compri al giorno d'oggi tipicamente prendono uno o due anni di sviluppo con squadre di ovunque comprese tra 10 e 50 persone. I budgets semplicemente ricchi di milioni di dollari. E tutte queste persone sono altamente esperte: programmatori, disegnatori d'arte, tecnici del suono, ecc.

Ma *GameMaker* ha cambiato questo. Con *GameMaker* puoi creare il tuo gioco per computer rapidamente senza bisogno di imparare un linguaggio di programmazione. Certo, non dovresti aspettarti di creare il tuo *Halo 4* o *Virtua Tennis* entro pochi mesi. Ma questo non è neanche necessario. La gioia di giocare un gioco che non è relativo alla sua complessità. Giochi semplici, come *Tetris*, *Bejeweled*, *Space Invaders*, ecc.. e tanti altri divertenti da giocare e facile da creare.

GameMaker offre un intuitivo e facile da usare un'interfaccia drag-e-drop che ti permette di creare i tuoi giochi molto rapidamente. Puoi anche importare e creare immagini, sprites (immagini animate) e suoni e usarli. *GameMaker* è in pacchetto con un considerevole collezione di tali risorse per farti iniziare. Puoi semplicemente definire gli oggetti nel tuo gioco e indicare i loro comportamenti, e puoi definire comode stanze (livelli) in cui il gioco prende posto. E se vuoi un controllo completo c'è effettivamente un facile da usare linguaggio di programmazione incluso in *GameMaker* che ti dà un controllo completo su tutto quello che succede nel tuo gioco.

GameMaker si focalizza su giochi a due dimensioni. Quindi lo scopo non è di creare mondi 3D tipo *Quake*, anche se c'è qualche funzionalità limitata per grafica 3D. Ma non ti abbattere. Molti grandi giochi usano tecnologie di sprite a due dimensioni, nonostante essi sembrano veramente a 3 dimensioni. E il disegno di giochi a 2 dimensioni è più facile e veloce.

Attualmente *GameMaker* arriva in due edizioni, la Lite Edition e la Standard Edition. La Lite Edition può essere usata gratuitamente ma è limitata nelle funzionalità e visualizzerà messaggi popup. Sebbene tu possa distribuire liberamente i tuoi giochi creati con esso; puoi anche venderli se vuoi. Vedi l'accordo della licenza inclusa per altri dettagli. Sei fortemente incoraggiato ad aggiornare la tua copia di *GameMaker* dalla Lite Edition. Estenderà considerevolmente le funzionalità di *GameMaker* e rimuoverà il logo nell'esecuzione dei giochi. Questo supporterà anche l'ulteriore sviluppo di *GameMaker*. Per altre informazioni sull'aggiornamento vedi la pagina [Standard Edition](#).

Questo file d'aiuto ti dirà sulle cose più importanti che devi conoscere su *GameMaker* e come potrai creare i tuoi giochi con esso. Per cortesia, realizza che, anche con un programma come *GameMaker*, il disegno di giochi per computer non è completamente senza sforzi. Ci sono molti aspetti che sono importanti: game play, grafica, suoni, interfaccia utente, ecc. Inizia con esempi semplici e realizzerai che la creazione di giochi è molto divertente. Controlla anche il sito web

<http://www.yoyogames.com/>

per altri esempi, tutorials, idee, e collegamenti ad altri siti e forums. E presto diventerai un maestro di creazione di giochi. Divertiti.

Installazione

Hai probabilmente già fatto questo ma se no, ecco come installare *GameMaker*. Semplicemente avvia il programma `gmaker80.exe`. Segui le istruzioni a schermo. Puoi installare il programma dovunque vuoi ma è meglio seguire i suggerimenti forniti di default. Dopo che l'installazione è completata, nel menu Start troverai un nuovo gruppo del programma dove puoi avviare *GameMaker* e leggere il file d'aiuto.

GameMaker installa anche un numero considerevole di immagini, sprites (immagini animate) ed effetti sonori sul tuo computer, che possono essere usati liberamente nei tuoi giochi. Anche alcuni esempi di giochi sono installati. Tutti questi possono essere trovati nelle cartelle dentro la posizione dove hai installato *GameMaker*.

La prima volta che avvi *GameMaker* ti viene chiesto se vuoi avviare il programma in modalità **Semplice** o **Avanzata**. Se non hai mai usato un programma di creazioni giochi e se non sei un programmatore con esperienza, è meglio utilizzare la modalità semplice (quindi seleziona **No**). Nella modalità semplice meno opzioni sono visualizzate. Puoi semplicemente cambiare alla modalità avanzata più tardi usando l'elemento appropriato nel menu **File**.

Ti sarà anche mostrato un tutorial a destra della finestra. Il tutorial ti insegnerà come creare velocemente la tua prima partita. Esso ti guiderà attraverso i passaggi di base nell'uso *GameMaker*. Se non hai mai utilizzato *GameMaker* prima si consiglia vivamente di lavorare col tuo senso attraverso il tutorial. È possibile sempre provare il tutorial in seguito attraverso l' **Help** dal menu.

Requisiti

Ogni computer con meno di 5 anni dovrebbe avviare *Game Maker* senza problemi.

Per essere più precisi, *Gamemaker* richiede un PC moderno ragionevole che avvia Windows 2000, XP, Vista, 7 o successivi. Un scheda grafica compatibile con DirectX 8 (o superiore) con almeno 32MB di memoria richiesta per la maggior parte dei giochi creati. Richiede una risoluzione dello schermo di almeno 800x600 e 65000 (16-bit) colori (preferibilmente colore completo). Anche una scheda sonora compatibile con DirectX8 è richiesta. Assicurati di avere i più recenti drivers installati. *GameMaker* richiede DirectX versione 8.0 o successivo per essere installato sul tuo computer. (Puoi anche scaricare la versione più nuova di DirectX dal sito Microsoft su: <http://www.microsoft.com/windows/directx/>.) Quando disegni e testi giochi, i requisiti di memoria sono piuttosto alti (almeno 128 MB e preferibilmente di più, dipende anche dal sistema operativo). Quando si eseguono solo i giochi, i requisiti di memoria sono meno alti e dipendono molto dal tipo di gioco.

Aggiornare dalla Lite Edition

GameMaker 8 è disponibile in due edizioni, la Lite Edition e la Standard Edition.

La **Lite Edition** è pensata per coloro che muovono i primi passi sul percorso dello sviluppo giochi. Può essere usata liberamente ma è limitata nelle funzionalità. Visualizza anche un logo popup quando si avviano i giochi e regolarmente ti rimanda all'aggiornamento del programma. Quando stai usando *GameMaker* regolarmente sei fortemente raccomandato ad aggiornare alla Lite Edition.

La **Standard Edition** contiene considerevolmente più funzionalità e non viene visualizzato alcun logo o messaggi di popup. Più precisamente, la Standard Edition ha le seguenti funzionalità aggiuntive:

- Nessun logo di *GameMaker 8* visualizzato quando si avvia un gioco.
- Nessun TV logo di *GameMaker* nell'angolo del gioco
- Nessuna schermata di pubblicità di *GameMaker* alla chiusura.
- Nessun popup regolare ti ricordano di aggiornare.
- Puoi usare gli sprites mescolati con colori, che possono essere usati per altri effetti speciali e ombre semplici.
- Ci sono opzioni aggiuntive negli editor sprite e immagine.
- Ci sono azioni aggiuntive, per esempio musica da CD, testo ruotato e forme colorate.
- Puoi usare effetti sonori speciali e suoni posizionali.
- Puoi creare splash screens con filmati, immagini, pagine web, testi, ecc.
- C'è un particolare sistema di particelle per creare esplosioni, fuochi d'artificio, fiamme, pioggia e altri effetti.
- Un numero di funzioni di disegno avanzati sono disponibili, per esempio testi colorati e poligoni texturizzati.
- E' possibile creare giochi 3D usando le funzioni per la grafica 3D.
- E' possibile creare giochi multigiocatore che possono essere giocati su una rete.
- Puoi definire le tue transizioni delle stanze (rooms).
- Puoi usare funzioni per creare, caricare, e modificare le risorse (sprites, sfondi, ecc.) mentre il gioco è avviato.
- C'è una collezione di funzione per creare e usare le strutture dati.
- Ci sono funzioni per la pianificazione del movimento.
- Ottieni la possibilità di includere files aggiuntivi negli eseguibili del gioco che possono essere usati quando il gioco è avviato.
- La Standard Edition può essere facilmente estesa usando i pacchetti d'estensione. Questi sono fatti da chiunque e in generale, sono forniti gratuitamente.
- Tre pacchetti d'estensione del genere sono inclusi aggiungendo molte transizioni di stanze (rooms), finestre di dialogo, e servizi di stampa.
- Puoi definire i tuoi eventi trigger.
- Puoi esportare ed importare risorse, che rende più facile la collaborazione sui giochi.

Aggiornare dalla Lite Edition costa solo \$39.99 (soggetto a cambiamenti) Questo è l'unica tassa che sarà valida per tutte le versioni 8.x di *GameMaker*.

Quando stai avviando la Lite Edition, puoi aggiornare a Standard usando la schermata di benvenuto quando apri *GameMaker*.

Per aggiornare dalla schermata di benvenuto, clicca semplicemente il pulsante **Purchase Now!**, poi procedi attraverso il processo di acquisto. Una volta che hai completato l'acquisto, vedrai visualizzato la tua nuova licenza che potrai copiare e incollare nella casella di testo nello Step 2, e cliccare il pulsante **Upgrade Now!**. *Game Maker* aggiornerà poi alla completa Standard Edition.

Il file di licenza ti sarà anche inviato per email usando il tuo indirizzo email inserito durante l'acquisto, e se hai effettuato l'accesso sullo store di YoYo Games, sarà anche legato a questo account, consentendo di recuperarlo in ogni momento. Se non effettui l'accesso, l'email conterrà anche i dettagli delle impostazioni del nuovo account usando l'indirizzo email che hai fornito. Questo ti permette di nuovo di recuperare il tuo codice di licenza di *Game Maker*.

Assicurati di salvare l'e-mail e il codice stesso, in quanto sarà necessario ogni volta che si desidera reinstallare *GameMaker*.

Puoi visualizzare di nuovo questa finestra di dialogo selezionando dal menu l'elemento **Purchase Upgrade from Lite Edition...**, come visualizzato sotto

□

Dopo aver comprato *GameMaker* (e quindi, avere una chiave di licenza), puoi andare al menu Help, e scegliere **Enter License Key**. Una volta che hai inserito una valida, la tua copia di *GameMaker* verrà aggiornata. Devi essere connesso a internet per aggiornare.

Mentre *GameMaker* da solo non richiede una connessione a internet, richiederà occasionalmente accesso per mantenere la licenza. Se non puoi connettere il tuo computer a internet, puoi scaricare il file di controllo licenza dal sito web di YoYoGames, e puntare al sistema di auto aggiornamento. Se require occasional access to maintain the license. If you can not connect your computer to the internet, you can download the license check file from YoYo Games website, and point the auto update system to it. Se non si riesce a fornire un file valido, o la connessione internete quando richiesta, la tua copia di *GameMaker* verrà declassata a Lite fino al momento in cui si farà.

Iniziare

Creare il tuo primo gioco è sempre un'impresa. Ma se sei disposto a metterci un po' di fatica, diventerà abbastanza facile. Puoi finirlo entro un'ora.

Anche se è veramente facile creare giochi con *GameMaker* avrai bisogno di capire alcuni concetti di base. Per questo scopo è fortemente raccomandato seguire il tutorial che viene mostrato quando *GameMaker* viene avviato. Se hai nascosto il tutorial, puoi sempre renderlo visibile di nuovo scegliendo **Tutorial** nel menu **Help**.

L'idea Globale

Prima di approfondire le possibilità di *GameMaker* sarebbe corretto farsi un'idea del funzionamento del programma. I giochi creati con *GameMaker* prendono posto in una o più *rooms* (stanze). Le *rooms* sono piatte, non 3D, ma possono contenere una grafica con aspetto 3D. In queste *rooms* si piazzano gli *objects* (oggetti), che puoi definire nel programma. Oggetti tipici sono i muri, le palle che si muovono, il personaggio principale, i mostri, ecc. Alcuni oggetti, come i muri, stanno fermi e non fanno niente. Gli altri oggetti, come il personaggio principale, si muoveranno intorno e reagiranno all'input del giocatore (tastiera, mouse, e joystick) e tra di loro. Per esempio, quando il personaggio principale incontra un mostro potrebbe morire. Gli oggetti sono gli ingredienti più importanti dei giochi creati con *GameMaker*, quindi parliamone un po' di più.

Prima di tutto, la maggior parte degli oggetti hanno bisogno di un'immagine per essere visibili nello schermo. Queste immagini sono chiamate *sprites*. Spesso uno *sprite* non è una singola immagine, ma una serie di immagini che vengono mostrate una dopo l'altra per creare un'animazione. In questo modo il personaggio sembrerà camminare, una palla ruotare, un'astronave esplodere, ecc. Durante il gioco, lo *sprite* per un particolare oggetto può cambiare. (Quindi il personaggio può avere un aspetto differente quando cammina a sinistra o a destra.) Puoi creare i tuoi *sprites* in *GameMaker* o caricarli dai files (ad esempio files PNG o animazioni GIF). In *GameMaker* sono inclusi molti *sprites* che puoi usare liberamente nei tuoi giochi.

Determinate cose accadranno agli oggetti. Questi avvenimenti sono chiamati *events* (eventi). Gli oggetti possono richiedere che avvengano delle determinate *actions* (azioni) quando succede qualcosa. Ci sono molti tipi di eventi e di azioni che i tuoi oggetti possono prendere. Per esempio, c'è un *creation event* quando l'oggetto viene creato. (Per essere più precisi, quando un'istanza di un oggetto viene creata; ci possono essere più istanze di uno stesso oggetto.) Per esempio, quando un oggetto palla viene creato puoi dargli delle azioni di movimento in modo da farlo iniziare a muovere. Quando due oggetti si incontrano, accade un *collision event* (evento di collisione). In tal caso puoi far fermare la palla o fargli cambiare direzione. Puoi anche far partire un effetto sonoro. Per questo scopo *GameMaker* ti permette di definire dei *sounds* (suoni). Quando il giocatore preme un tasto nella tastiera c'è un *keyboard event*, e l'oggetto può richiedere un'azione appropriata, come muoversi nella direzione indicata. Speriamo che hai afferrato l'idea. Per ogni oggetto che progetti, puoi indicare delle azioni per i vari eventi; in questo modo definisci il comportamento dell'oggetto.

Una volta definiti i tuoi oggetti è tempo di definire le *rooms* nelle quali essi vivranno. Le *rooms* possono essere usate come livelli per il tuo gioco. Ci sono delle azioni per muoversi da una *room* all'altra. Le *rooms*, prima di tutto, hanno un *background* (sfondo). Questo può essere un semplice colore o un'immagine. Questi sfondi possono essere creati da *GameMaker* o caricati dai files. (Lo sfondo può fare molte cose, ma per ora consideralo come qualcosa che rende le *rooms* carine.) Dopo, puoi piazzare gli oggetti nella *room*. Puoi piazzare più istanze di uno stesso oggetto in una *room*. Quindi, per esempio, hai bisogno di definire un solo oggetto muro, e piazzarlo più volte in posti differenti. Puoi anche avere più istanze dello stesso oggetto mostro, che avranno lo stesso comportamento.

Adesso sei pronto per far partire il gioco. La prima *room* verrà mostrata e gli oggetti prenderanno vita a causa delle azioni nei loro eventi di creazione. Loro cominceranno a reagire tra di loro in base alle azioni nei loro eventi di collisione e potranno reagire al giocatore usando le azioni negli eventi di tastiera o di mouse.

In sintesi, queste cose (spesso chiamate risorse), giocano un ruolo fondamentale:

- *objects*: che sono le reali entità del gioco
- *rooms*: i luoghi (livelli) in cui gli *objects* vivono
- *sprites*: le immagini (animate e non) che rappresentano gli *objects*
- *sounds*: che possono essere usati nel gioco come sottofondo musicale o effetti sonori

- *backgrounds*: le immagini usate come sfondo per le rooms

Ci sono anche altri tipi di risorse: paths (percorsi), scripts, fonts, e time lines (linee del tempo). Questi sono importanti solo per giochi più complicati. Li vedrai solo quando farai partire *GameMaker* in advanced mode (modalità avanzata). Essi verranno trattati nei capitoli avanzati di questo documento.

L&E™ interfaccia utente globale

Quando avviate *GameMaker*, viene mostrata la seguente interfaccia. Notare che quest'interfaccia potrebbe mostrare anche le news e i tutorial potrebbero essere visibili sul lato destro di *GameMaker*.

(Di fatto, questo form &E" quello che vedete quando eseguite *GameMaker* in modalit&A semplice (simple mode). Nella modalit&A advanced, sono visibili nel form ulteriori voci). Alla sinistra, sono visibili le differenti risorse menzionate sopra : Sprites, Sounds, Backgrounds, Objects, Rooms e due in pi&A¹. Game Informations, e Global Game Settings. In alto &E" visibile il familiare menu e la barra degli strumenti (toolbar). In questo capitolo descriveremo brevemente, le varie voci del menu, pulsanti etc. Negli ultimi capitoli li descriveremo pi&A¹ approfonditamente. Notate che molte cose possono essere compiute in maniere differenti: scegliendo un comando dal menu, cliccando un pulsante, o cliccando con il pulsante destro su una risorsa..

File menu

Il menu file ospita alcuni comandi tipici per caricare e salvare files, pi&A¹ altri speciali:

- **New.** Scegliete questo comando per iniziare a creare un nuovo gioco. Se il gioco gi&A in esecuzione &E" presente vi verr&A chiesto di salvarlo. Esiste un pulsante nella toolbar per questa funzione.
- **Open.** Aprite un file di gioco. I file di *GameMaker* hanno l'estensione .gm81. Puoi aprire anche i vecchi file .gmk o .gm6. (Se volete aprire i file .gmd creati con la versione 5 di *GameMaker* dovreste selezionare l'appropriato tipo di file in basso alla finestra. Questi potrebbero non funzionare correttamente nella nuova versione.) C'&E" una toolbar per questi comandi. Puoi anche aprire un gioco spostando il file del gioco nella finestra di *GameMaker*.
- **Recent Files.** Usate questo submenu per riaprire giochi recentemente aperti.
- **Save.** Salva i progetti di gioco usando il nome corrente. Se non &E" stato precedentemente specificato un nome vi verr&A chiesto d'inserirne uno nuovo. Potete usare questo comando solo quando il file &E" stato cambiato. Ancora per questo esiste un pulsante nella toolbar.
- **Save As.** Salvate il progetto con un nome differente. Vi verr&A chiesto di inserire un nuovo nome.
- **Create Executable.** Una volta che il vostro gioco sar&A pronto avrete il piacere di mostrarlo ad altri. Usando questo comando potete creare una versione stand-alone del vostro gioco. (un file direttamente eseguibile).
- **Advanced Mode.** Quando cliccate su questo comando *GameMaker* sceglier&A di cambiare dalla modalit&A semplice (simple) a quella avanzata (advanced). Nella modalit&A avanzata sono disponibili comandi e risorse supplementari.
- **Exit.** Probabilmente ovvio. Premendo questo pulsante uscirete dall&E™ applicazione. Se avete cambiato il file in esecuzione vi verr&A chiesto di salvarlo.

Edit menu

Il menu edit contiene una lista di comandi relativi alla risorsa corrente selezionata (object, sprite, sound, etc.). A seconda del tipo di risorsa alcuni comandi non sono visibili.

- **Insert resource.** Inserisce una nuova istanza del tipo corrente di risorsa selezionata prima di quella attuale. Si aprir&A un form nel quale poter cambiare le propriet&A della risorsa. Questo passaggio sar&A trattato in dettaglio nei capitoli successivi.
- **Duplicate.** Esegue una copia della risorsa corrente e l&E™ aggiunge. E&E™ aperto un form nel quale poter cambiare la risorsa.
- **Delete.** Cancella la risorsa selezionata corrente. (o gruppo di risorse). Prestate attenzione. Questa funzione non permette di essere annullata. In ogni caso comparir&A un messaggio d&E™ avviso.
- **Rename.** Da alla risorsa un nuovo nome. Questa funzione pu&A² essere eseguita anche dal form di propriet&A per la risorsa. E&E™ possibile selezionare questa risorsa e quindi cliccare sul nome.
- **Properties.** Usate questo comando per far apparire il form per editare le preferenze. Prendete nota che tutti i forms delle propriet&A appaiono all&E™ interno del form principale. E&E™ possibile editare molte di esse contemporaneamente. E&E™ possibile editare le propriet&A cliccando due volte sulla risorsa.
- **Set Transparency Background.** Qui puoi indicare quanta dev'essere la trasparenza dello sprite che viene mostrato

nello sprite editor. Puoi anche usare un pattern modificato, o un colore che puoi modificare cliccando nella color box.

Si noti che tutti questi comandi possono essere impartiti in modo alternativo. Click del pulsante destro del mouse sulla risorsa o gruppo di risorse, e apparirà l'appropriate menu pop up.

Resources menu

In questo menu, è possibile aggiungere sia nuove risorse che di tipo differente. Si noti che per ognuna di esse, esiste un pulsante nella toolbar ed una scorciatoia da tastiera. Puoi anche modificare le informazioni del gioco e le impostazioni globali del gioco.

Run menu

Questo menu viene usato per eseguire il gioco. Ci sono due modalità di esecuzione:

- **Run normally.** Avvia il gioco normalmente. Il gioco è avviato nel miglior modo possibile, e sarà come giocare con l'eseguibile.
- **Run in Debug mode.** Esegue il gioco nel modo debug. In questo metodo è possibile controllare determinati aspetti del gioco. Potete metterlo in pausa e controllare lo step. Questo metodo anche se leggermente complesso è utile nel caso qualcosa andasse per il verso sbagliato.

Una volta terminato il gioco, si può creare un file eseguibile singolo per il gioco usando il comando nel menu file.

Window menu

In questo menu troverai alcuni dei comandi per gestire le diverse proprietà della finestra nel form principale:

- **Cascade.** Permette la visualizzazione a cascata delle finestre cosí che possano essere tutte parzialmente visibili.
- **Arrange Icons.** Dispone tutte le proprietà iconificate delle finestre. (Utile particolarmente quando si ridimensiona la finestra del form principale).
- **Close All.** Chiude tutte le proprietà delle finestre, chiedendo all'utente se vorrà o meno salvare le modifiche.

Help menu

In questo menu trovate alcuni comandi di aiuto:

- **Contents.** Usate questo comando per mostrare questo file d'aiuto.
- **Tutorials.** Usate questo submenu per mostrare i differenti tutorial che sono forniti con *GameMaker* per insegnarti a creare il tuo primo gioco.
- **Upgrade from Lite Edition.** Puoi usare questo comando per aggiornare dalla Lite Edition di *GameMaker* online. La Standard Edition ha caratteristiche in più.
- **Enter Activation Code.** Se hai comprato *GameMaker* prima (e quindi, hai un codice d'attivazione o la referenza di un vecchio acquisto) puoi utilizzare questo comando per inserire il tuo codice. Verrai spostato su una pagina web dove puoi inserire il tuo codice di attivazione o la referenza del tuo vecchio pagamento.
- **News.** Qui puoi vedere le più recenti notizie su *GameMaker*.
- **More Tutorials.** Questo comando ti porterà in un sito dove potrai scaricare molti più tutorial.
- **Website.** Ti collega al sito di *GameMaker* dove puoi trovare tutte le informazioni sulla versione più recente di *GameMaker* e le collezioni di giochi e risorse per *GameMaker*.
- **Forum.** Questo comando ti porterà al forum dove gli utenti si aiutano l'un l'altro sui molti aspetti di *GameMaker*.
- **Wiki.** Questo comando ti porterà al wiki di *GameMaker* dove troverai molte informazioni sugli usi di *GameMaker*.
- **Report a bug.** Mentre noi facciamo di tutto per far sí che *GameMaker* sia libero dai bug, un programma come questo è impossibile testarlo. Quindi, se individuate qualcosa che pensiate sia un bug, siete pregati di usare questo link e riportarcelo, in modo da poter fare del nostro meglio per correggerlo.
- **About GameMaker.** Da alcune informazioni sulla tua versione di *GameMaker*.

The resource explorer

Alla sinistra del form principale si trova la risorsa explorer. Qui Ã visibile la struttura ad albero di tutte le risorse del proprio gioco. La risorsa explorer funziona allo stesso modo di Windows Explorer, e sar di facile uso. Se una voce presenta il segno + di fronte Ã possibile cliccare sul segno per vedere le risorse dentro di essa. Cliccando sul segno â la lista scomparirÃ. EÃ possibile cambiare il nome della risorsa (eccetto la piÃ alta nella lista) selezionando (con un singolo click del mouse) e successivamente sul nome. Doppio click sulla risorsa per editare le sue proprietÃ. Usate il pulsante destro del mouse per accedere ai stessi comandi come nel menu Edit.

EÃ possibile cambiare lâ ordine delle risorse cliccando su di esse con il mouse e tenendo premuto il pulsante. Posizionate la risorsa nellâ apposito posto. (Certamente il posto puÃ essere ricambiato. Non si puÃ spostare un suono nella lista degli sprites.)

Definire gli Sprites

Gli sprites sono la rappresentazione visiva di tutti gli oggetti nel gioco. Uno sprite $\hat{=}$ sia una singola immagine, disegnata con qualsiasi programma si preferisce, o un set di immagini che, quando eseguite una dopo l'altra, assomigliano ad una animazione. Per esempio, le seguenti quattro immagini formano uno sprite di un personaggio che si muove a destra.

Mentre crei un gioco solitamente inizi collezionando un set di sprite per gli oggetti nel tuo gioco. Un considerevole numero di sprite $\hat{=}$ compreso con *GameMaker*. Altre collezioni di interessanti sprite possono essere trovate sul sito di *GameMaker*. Altre ancora nel web, normalmente nel formato png o gif animate.

Per creare uno sprite, seleziona l'oggetto **Create Sprite** dal menu **Resources**, o utilizza il pulsante corrispondente nella toolbar. Il seguente menu dovrebbe apparire.

In alto a sinistra potrai indicare il nome dello sprite. Tutti gli sprite (e tutte le risorse) hanno un nome. La miglior cosa $\hat{=}$ dare un nome che descrive lo sprite. Devi far s $\hat{=}$ che tutte le risorse abbiano nomi diversi. Anche se questo non $\hat{=}$ strettamente richiesto, vi consigliamo di usare per il nome dello sprite solo lettere e numeri e il simbolo underscore (_) (vale anche per le altre risorse) preferibilmente iniziando con una lettera. In modo particolare non usate il carattere spazio. Questo diventer $\hat{=}$ importante una volta che inizierete ad usare il codice.

Per caricare uno sprite, cliccate sul bottone **Load Sprite**. Una finestra per file speciali verr $\hat{=}$ aperta, dove potrete scegliere lo sprite:

La parte sinistra sembra come un normale selettore di file dove puoi selezionare lo sprite che vuoi. A destra puoi avere un anteprima dello sprite animato e alcune informazioni su di esso. Qui potete inoltre indicare se volete rendere lo sprite opaco (questo, rimuove tutte le parti trasparenti), se volete rimuovere il background, se volete renderlo trasparente (default), e se volete arrotondare gli angoli dello sprite, che pu $\hat{=}$ migliorare la sua apparenza. Quando sei contento del risultato, premi **Open** per caricare lo sprite.

GameMaker pu $\hat{=}$ caricare diversi tipi di file grafici. Quando caricate una gif animata, le diverse subimmagini formano le immagini degli sprite. Quando i nomi dei file finiscono con _stripXX, le XX sono un numero, si ritiene che contenga la striscia di XX subimmagini una dopo l'altra (non per i file GIF). Per esempio, un file immagine con il nome ball_strip4.png verr $\hat{=}$ contata avente 4 subimmagini.

Una volta che lo sprite $\hat{=}$ caricato la prima subimmagine verr $\hat{=}$ mostrata a destra. Quando ci sono pi $\hat{=}$ subimmagini, potrai cambiarle con le frecce.

Con i bottoni **Edit Sprite** potete modificare gli sprite, o creare un nuovo sprite. *GameMaker* ha una finestra di creazione sprite e un editor di immagini. Per pi $\hat{=}$ informazioni guardare le sezioni su [Modificare i tuoi sprite](#) e [Modificare le subimmagini individuali](#).

Suoni e Musica

Molti giochi hanno degli effetti sonori e della musica di sottofondo. Alcuni effetti sonori utili possono essere trovati nel sito web di *GameMaker*. Altri possono essere trovati in altri posti sul web.

Per creare una risorsa suono (un sound) nel tuo gioco, usa l'elemento **Create Sound** nel menu **Resources** oppure usa il tasto corrispondente nella barra degli strumenti. La seguente finestra si aprirà.

□

Per caricare un suono, premi il bottone etichettato **Load Sound**. Si aprirà una finestra per selezionare il file. Ci sono due tipi di file sonori, i files wave e midi. I files wave vengono usati per degli effetti sonori brevi. Usano molta memoria, ma vengono riprodotti immediatamente. Usali per tutti gli effetti sonori del tuo gioco. I files midi descrivono la musica in un modo differente. Come risultato essi usano molta memoria in meno, ma sono limitati alla musica di sottofondo strumentale. Inoltre, può essere riprodotto solo un file midi alla volta.

Una volta caricato il file midi puoi ascoltarlo premendo il tasto play. C'è anche il bottone **Save Sound** per salvare il suono attuale in un file. Questo bottone non è realmente necessario ma potresti averne bisogno nel caso che tu perda il suono originale.

Backgrounds

Il terzo tipo di risorse sono i backgrounds. I backgrounds sono di solito grandi immagini che vengono usate come sfondo per le rooms nel quale il gioco prende posto. Spesso le immagini sfondo sono fatte in modo da rivestire un'area senza incrinature visuali. In questo modo puoi riempire un background con dei pattern. Alcuni backgrounds sono inclusi con *GameMaker*. Altri possono essere trovati nel sito web di *GameMaker*. Altri ancora possono essere trovati in altri posti sul web.

Per creare una risorsa background nel tuo gioco, usa l'elemento **Create Background** nel menu **Resources** o usa il bottone corrispondente nella barra degli strumenti. Si aprirà la finestra seguente.

□

In alto a sinistra puoi indicare il nome dello sfondo. Ti raccomandiamo fortemente di dare a tutti gli sfondi (e alle altre risorse) un nome descrittivo.

Premi il bottone **Load Background** per caricare un'immagine background. Verrà mostrato un selettore di file in cui potrai selezionare il tuo background. A destra della finestra puoi indicare se vuoi creare un background opaco (rimuovendo ogni parte trasparente), o se rimuovere il background, rendendolo trasparente (default no), e se vuoi smussare i bordi del background, di cui puoi migliorare l'aspetto quando è parzialmente trasparente. Quando sei contento del risultato premi **Open** per caricare lo sfondo. *GameMaker* supporta molti formati di immagine. Le immagini background non possono essere animate!

Puoi cambiare il background o crearne uno nuovo usando il bottone **Edit Background**. Questo aprirà un estensivo editor di immagini. Per informazioni su come usarlo guarda la sezione [Modificare le immagini](#).

Stai attento con le immagini grandi. Alcune schede grafiche vecchie non possono trattare con immagini più grandi dello schermo. Quindi mantieni la dimensione dei tuoi background inferiore a 1024x1024.

Definire gli Objects

Con le risorse che hai visto puoi aggiungere delle ottime immagini e suoni al gioco, ma essi non fanno niente. Adesso veniamo alla risorsa pi importante di *GameMaker*, gli objects (oggetti). Gli objects sono entit nel gioco che fanno delle cose. La maggior parte delle volte essi hanno uno sprite come rappresentazione grafica quindi tu li vedrai. Essi hanno un comportamento perch possono reagire a certi eventi. Tutte le cose che vedi nel gioco (ad eccezione dei background) sono oggetti. (O per essere pi precisi, essi sono istanze di oggetti.) I personaggi, i mostri, le palle, i muri, ecc. sono tutti oggetti. Ci potrebbero essere anche degli oggetti che tu non vedi, ma che controllano certi aspetti del gioco.

Per favore impara la differenza tra sprites e objects. Gli sprites sono delle immagini (animate e non) che non hanno nessun comportamento. Gli objects normalmente hanno uno sprite per rappresentarli ma gli objects hanno un comportamento. Senza gli objects non c' il gioco!

Impara anche la differenza tra objects e instances (istanze). Un object descrive una certa entit, per esempio un mostro. Ci possono essere pi istanze di questo oggetto nel gioco. Quando parliamo di un'istanza intendiamo una particolare istanza di un oggetto. Quando parliamo di un oggetto intendiamo tutte le istanze di questo oggetto.

Per creare un oggetto nel tuo gioco, scegli **Create Object** dal menu **Resources** Apparir la seguente finestra:

□

Questo  piuttosto complesso. A sinistra ci sono delle informazioni generali riguardo all'oggetto. Nel mezzo c' una lista di eventi che possono accadere all'oggetto. A destra c' sono le differenti azioni che l'oggetto pu eseguire. Parleremo di eventi e azioni nei prossimi capitoli.

Come sempre, puoi (anzi, devi) dare un nome al tuo oggetto. Dopo puoi scegliere lo sprite per l'oggetto. Per questo scopo, clicca col tasto sinistro del mouse nella casella dello sprite o nel bottone del menu vicino ad esso. Un menu apparir con tutti gli sprite disponibili. Seleziona quello che vuoi usare per l'oggetto. Se non hai ancora uno sprite, puoi cliccare il bottone **New** per creare una nuova risorsa sprite e cambiarla. Inoltre, quando selezioni una risorsa ci sar un bottone **Edit** che puoi usare per cambiare lo sprite. Questo  pi veloce rispetto al cercare la risorsa nella lista delle risorse e dopo indicare quella che vuoi modificare.

Dopo questo ci sono due caselle di controllo. **Visible** indica se le istanze di questo oggetto sono visibili. Chiaramente, la maggior parte degli oggetti  visibile, ma a volte  utile avere degli oggetti invisibili. Per esempio, can use them for waypoints for a moving monster. Invisible objects will puoi reagire agli eventi e le altre istanze possono collidere con esso. La casella etichettata **Solid** indica se questo  un oggetto solido (come un muro). Le collisioni con gli oggetti solidi vengono trattate in modo differente dalle collisioni con gli oggetti non solidi. Ti raccomandiamo fortemente di usare **Solid** solo per gli oggetti che non si muovono.

Eventi

GameMaker usa un approccio orientato agli eventi e funziona nel seguente modo. Ogni volta che accade qualcosa nel gioco, le istanze degli oggetti richiamano degli eventi (un tipo di messaggio che dice che qualcosa Ã accaduto). Le istanze possono quindi "reagire" a questo tipo di messaggi eseguendo delle azioni. Per ogni oggetto potrai utilizzare una serie di eventi nei quali dovrai inserire delle azioni. Prima di tutto, per molti eventi, l'oggetto non dovrÃ fare niente, per altri invece Ã richiesto che avvenga qualcosa, dovrai quindi impostarlo tramite drag&drop per indicare l'azione.

Nel Form delle proprietÃ dell'oggetto, c'Ã una lista di eventi ai quali l'oggetto dovrÃ reagire. Inizialmente Ã vuoto. Puoi aggiungere un evento premendo il bottone **Add Event**. ApparirÃ un altro form in cui potrai scegliere tra diversi tipi di eventi. Qui potrai selezionare l'evento che vuoi aggiungere. Avolta un menu apparirÃ per scegliere delle impostazioni extra. Per esempio, per gli eventi legati alla tastiera dovrai scegliere il pulsante a cui associare l'evento. In basso troverai una lista completa degli eventi, compresa la descrizione. Puoi cambiare un evento semplicemente cliccando su "change" e sceglierne un altro. Nel prossimo capitolo troverai una descrizione delle azioni che possono eseguire gli eventi. (Queste azioni si trovano all'estrema destra dell'interfaccia e sono raggruppate in delle schede. Le azioni possono essere "inserite" in un evento semplicemente trascinando l'icona nel riquadro a destra del riquadro eventi. Puoi posizionare una o piÃ¹ azioni nell'ordine che preferisci. Quando inserirai un'azione, si aprirÃ una finestra in cui dovrai inserire dei parametri relativi a quell'azione oppure del codice gml (GameMaker Language). La schermata dovrebbe apparire in questo modo

□

Adesso puoi iniziare aggiungendo azioni ad un altro evento. Clicca col tasto sinistro del mouse sull'evento, poi prendi e trascina delle azioni all'interno del riquadro relativo a quell'evento.

Puoi cambiare l'ordine delle azioni nella lista trascinandole col mouse. Se tieni premuto il tasto <Alt> mentre trascini, puoi fare una copia dell'azione. Puoi trascinare le icone anche nella lista azioni di un altro oggetto. Se clicchi col tasto destro del mouse su un'azione apparirÃ un menu in cui puoi cancellarla (o usare il tasto) o copiare/incollare le azioni (puoi usare <Shift>/<Ctrl> per selezionare piÃ¹ azioni contemporaneamente, invece <Ctrl><A> per selezionare tutte le azioni) Se tieni fisso il mouse sopra l'icona di un'azione, apparirÃ una breve descrizione.

Per cancellare l'azione selezionata clicca sul bottone **Delete** posizionato in basso. Se non ci sono azioni nell'evento, questo verrÃ cancellato alla chiusura. Ricorda: anche se hai assegnato delle azioni, ma vuoi cambiare l'evento (per esempio se vuoi usare l'evento associato ad un altro tasto), puoi farlo tramite il bottone **Change** situato in basso, potrai quindi scegliere un nuovo evento dalla finestra che si aprirÃ. Puoi anche duplicare un evento col tasto destro del mouse, apparirÃ una finestra, scegli l'evento che vuoi e verranno copiate le azioni dell'altro evento, nel nuovo.

Come detto sopra, per aggiungere un evento premi il bottone **Add Event**. ApparirÃ il seguente Form

□

Qui sceglierai l'evento che vuoi aggiungere. Per alcuni eventi, dopo aver cliccato dovrai scegliere per una sottocategoria. Di seguito una descrizione dei vari eventi:

□ **Evento Create (creazione)**

Questo evento si attiva quando un'istanza di un oggetto viene creata. Ã normalmente usata per settare alcune variabili o azioni che avvengono solo una volta.

□ **Evento Destroy (distruzione)**

Questo evento si attiva quando l'istanza viene distrutta. Per essere precisi, appena prima che venga distrutta, quindi l'istanza ancora esiste quando l'evento viene eseguito! Questo evento Ã di solito usato per cambiare il punteggio, diminuire le vite del personaggio o creare altre istanze di oggetti.

□ **Evento Alarm (svegliare/timer)**

Ogni istanza ha 12 alarm. L'alarm diminuisce di 1 ogni step finchÃ non raggiunge il valore 0. In quel momento, si attiveranno le azioni che hai scelto. Gli alarm sono veramente utili, perchÃ puoi usarli per far accadere determinate cose, dopo un tot di tempo. Un esempio di utilizzo, puÃ² essere far cambiare direzione ad un mostro ogni 20 step.

□ **Evento Step**

L'evento step si attiva ogni istante che passa nel gioco. Qui puoi inserire le azioni che devono essere eseguite

continuamente. Per esempio se un oggetto deve seguire un altro, qui puoi modificare la direzione del movimento, puntando verso l'oggetto da seguire. Presta attenzione però. E' sconsigliato usare azioni molto complesse nell'evento Step di oggetti che hanno molte istanze. Il gioco potrebbe perdere velocità. Per essere precisi, esistono diversi eventi Step. Normalmente ti basterà usare quello standard. Ma usando il menu puoi anche scegliere tra Evento Begin Step e Evento End Step. L'evento Begin Step viene eseguito all'inizio di ogni step, prima di ogni altro evento. L'evento Step (normale) viene eseguito appena prima che le istanze vengano posizionate nelle loro nuove posizioni. L'evento End Step viene eseguito alla fine dello step, appena prima dell'evento Draw(disegno). Questo è tipicamente usato per cambiare Sprite in base alla nuova direzione.

□ **Evento Collision (collisione)**

Ogni volta che 2 istanze collidono (i loro sprites si sovrappongono) si attiva l'evento collisione. Per essere precisi, accadono 2 eventi collisione, uno per ogni istanza. L'istanza può reagire a questa collisione, con delle azioni. Per inserire delle azioni, sempre tramite il bottone Add Event puoi scegliere collision e infine decidere verso quale oggetto "reagire" in caso di collisione. Potrai quindi aggiungere delle azioni nell'apposito riquadro a destra.

C'è una differenza in quello che accade in caso di Collisione per gli oggetti solidi e non-solidi. Se non ci sono azioni nell'evento Collision, non accadrà niente (esempio: 2 palline che si scontrano, si attraverseranno) Quando invece ci sono azioni, accade la seguente cosa:

Quando l'altro oggetto è solido, l'istanza è posizionata indietro nel punto dove si trovava lo step precedente alla collisione. Quindi vengono eseguite le azioni. In fine l'istanza viene spostata alla sua nuova posizione. Così ad esempio, se l'azione dice di "invertire la direzione di spostamento" l'istanza rimbalza contro il muro senza fermarsi. Se continua a esserci collisione, l'istanza viene posizionata alla sua posizione precedente. Quindi si fermerà.

Quando l'altro oggetto non è solido l'istanza non è posizionata indietro. l'evento viene semplicemente eseguito con l'istanza alla posizione corrente. Inoltre, non c'è un secondo controllo di collisione (come nel caso precedente).

Ci sono molti utilizzi per l'evento collisione. Le istanze possono usarlo per rimbalzare nei muri, oppure non appena collidono vengono distrutti (es. un proiettile).

□ **Keyboard events**

When the player presses a key, a keyboard event happens for all instances of all objects. There is a different event for each key. In the menu you can pick the key for which you want to define the keyboard event and next drag actions there. Clearly, only a few objects need events for only a few keys. You get an event in every step as long as the player keeps the key depressed. There are two special keyboard events. One is called <No key>. This event happens in each step when no key is pressed. The second one is called <Any key> and happens whatever key is pressed. When the player presses multiple keys, the events for all the keys pressed happen. Note that the keys on the numeric keypad only produce the corresponding events when <NumLock> is pressed.

□ **Mouse events**

A mouse event happens for an instance whenever the mouse cursor lies inside the sprite representing the instance. Depending on which mouse buttons are pressed you get the no button, left button, right button, or middle button event. The mouse button events are generated in each step as long as the player keeps the mouse button pressed. The press events are only generated once when the button is pressed. The release events are only generated when the button is released. Note that these events only occur when the mouse is above the instance. If you want to react to mouse press or release events at an arbitrary place, use the global mouse events that can be found in a submenu. There are two special mouse events. The mouse enter event happens when the mouse enters the instance. The mouse leave event happens when the mouse leaves the instance. These events are typically used to change the image or play some sound. Mouse wheel up and mouse wheel down events happen when the user moves the mouse wheel. Finally there are a number of events related to the joystick. You can indicate actions for the four main directions of the joystick (in a diagonal direction both events happen). Also you can define actions for up to 8 joystick buttons. You can do this both for the primary joystick and the secondary joystick.

□ **Other events**

There are a number of other events that can be useful in certain games. They are found in this menu. The following events can be found here:

- **Outside room:** This event happens when the instance lies completely outside the room. This is typically a good moment to destroy it.
- **Intersect boundary:** This event happens when the instance intersects the boundary of the room, that is, it lies (at least) partially outside the room.

- **Views:** Here you find a number of events that are useful when you use views in your rooms. These events test whether the instance lies completely outside a particular view or intersects the view boundary.
- **Game start:** This event happens for all instances in the first room when the game starts. It happens before the room start event (see below) but after the creation events for the instances in the room. This event is typically defined in only one "controller" object and is used to start some background music and to initialize some variables, or load some data.
- **Game end:** The event happens to all instances when the game ends. Again typically just one object defines this event. It is for example used to store certain data in a file.
- **Room start:** This event happens for all instances initially in a room when the room starts. It happens after the creation events.
- **Room end:** This event happens to all existing instances when the room ends.
- **No more lives:** *GameMaker* has a built-in lives system. There is an action to set and change the number of lives. Whenever the number of lives becomes less than or equal to 0, this event happens. It is typically used to end or restart the game.
- **No more health:** *GameMaker* has a built-in health system. There is an action to set and change the health. Whenever the health becomes less than or equal to 0, this event happens. It is typically used to reduce the number of lives or to restart the game.
- **Animation end:** As indicated above, an animation consists of a number of images that are shown one after the other. After the last one is shown we start again with the first one. The event happens at precisely that moment. As an example, this can be used to change the animation, or destroy the instance.
- **End of path:** This event happens when the instance follows a path and the end of the path is reached.
- **Close button:** This event happens when the user clicks on the close button of the window. This only happens when disabling in the game settings the option to have the close button behave as the Escape key.
- **User defined:** There are 16 of these events. They normally never happen unless you yourself call them from a piece of code.

□ Draw event

Instances, when visible, draw their sprite in each step on the screen. When you specify actions in the drawing event, the sprite is not drawn, but these actions are executed instead. This can be used to draw something other than the sprite, or first make some changes to sprite parameters. There are a number of drawing actions that are especially meant for use in the drawing event. Note that the drawing event is only executed when the object is visible. Also note that, independent of what you draw, collision events are based on the sprite that is associated with the instance.

□ Key Press events

This event is similar to the keyboard event but it happens only once when the key is pressed, rather than continuously. This is useful when you want an action to happen only once.

□ Key Release events

This event is similar to the keyboard event but it happens only once when the key is released, rather than continuously.

In some situation it is important to understand the order in which *GameMaker* processes the events. This is as follows:

- Begin step events
- Alarm events
- Keyboard, Key press, and Key release events
- Mouse events
- Normal step events
- (now all instances are set to their new positions)
- Collision events
- End step events
- Draw events

The create, destroy, and other events are performed when the corresponding things happen.

Azioni

Le azioni indicano le cose che accadono in un gioco creato con *GameMaker*. Le azioni vengono piazzate negli eventi degli oggetti. Quando l'evento prende posto queste azioni vengono eseguite, formando il comportamento delle istanze dell'oggetto. C'è un gran numero di azioni differenti disponibili ed è importante che tu capisca cosa fanno. In questo capitolo descriveremo le azioni disponibili nella simple mode (modalità semplice). Nota che alcune di queste sono disponibili solo nella Standard Edition (versione standard) di *GameMaker*. Questo verrà indicato.

Tutte le azioni si trovano nelle schede a destra della finestra delle proprietà dell'oggetto. Ci sono sei insiemi di azioni. Puoi selezionare quello che vuoi cliccando nella scheda corretta. Quando tieni il puntatore del mouse sopra un'azione, viene mostrata una descrizione breve.

Ripetiamo brevemente: Per mettere un'azione in un evento, trascinala dalla scheda alla lista delle azioni. Puoi cambiare l'ordine nella lista, sempre trascinando. Premendo il tasto <Alt> durante il trascinamento viene fatta una copia dell'azione. (Puoi trascinare e copiare le azioni tra le liste nelle differenti finestre delle proprietà degli oggetti.) Usa il tasto destro del mouse e seleziona l'elemento del menu corretto per rimuovere le azioni (o usa il tasto) e per copiare e incollare le azioni selezionate.

Quando trascini un'azione nella lista delle azioni, verrà mostrata una finestra su cui potrai riempire certi parametri per l'azione. I parametri verranno descritti sotto quando descriveremo le azioni. Appaiono due tipi di parametri in molte azioni quindi questi li descriveremo qui. Di sopra puoi indicare a quale istanza l'azione dev'essere applicata. *self* è l'opzione default, che è l'istanza per la quale l'azione viene eseguita. La maggior parte delle volte, *self* è quello che ti serve. Nel caso degli eventi di collisione, puoi anche specificare l'azione all'altra istanza coinvolta nella collisione. Dall'istanza, in questo modo, puoi distruggere l'altra istanza. Infine, puoi scegliere di applicare l'azione a tutte le istanze di un particolare oggetto. In questo modo puoi cambiare tutte le palle rosse in palle verdi. Il secondo tipo di parametro è la casella etichettata con **Relative**. Selezionando questa casella, i valori che inserisci sono relativi ai valori attuali. Per esempio, in questo modo puoi aggiungere qualcosa al punteggio attuale, invece di cambiarlo col nuovo valore. Gli altri parametri saranno descritti sotto. Puoi cambiare dopo i parametri doppio-cliccando nell'azione.

Possono essere trovate delle informazioni sulle differenti azioni nelle pagine seguenti:

[Azioni di Movimento](#)

[Azioni Principali, Set 1](#)

[Azioni Principali, Set 2](#)

[Azioni di Controllo](#)

[Azioni di Punteggio](#)

[Azioni di Disegno](#)

[Usare le Variabili e le Espressioni](#)

Azioni di Movimento

The first set of actions consists of those related to movement of objects. The following actions exist:

☐ **Move Fixed**

Use this action to start the instance moving in a particular direction. You can indicate the direction using the buttons with the arrows on it. Use the middle button to stop the motion. Also you need to specify the speed of the motion. This speed is given in pixels per step. Preferably don't use negative speeds. You can specify multiple directions. In this case a random choice is made. In this way you can let a monster start moving either left or right.

☐ **Move Free**

This is the second way to specify a motion. Here you can indicate a precise direction. This is an angle between 0 and 360 degrees. 0 means to the right. The direction is counter-clockwise. So for example 90 indicates an upward direction. If you want an arbitrary direction, you can type `random(360)`. As you will see below the function `random` gives a random number smaller than the indicated value. As you might have noticed there is a checkbox labeled **Relative**. If you check this, the new motion is added to the previous one. For example, if the instance is moving upwards and you add some motion to the left, the new motion will be upwards to the left.

☐ **Move Towards**

This action gives a third way to specify a motion. You indicate a position and a speed and the instance starts moving with the speed towards the position. (It won't stop at the position!) For example, if you want a bullet to fly towards the position of the spaceship you can use as position `spaceship.x`, `spaceship.y`. (You will learn more about the use of variables like these below.) If you check the **Relative** box, you specify the position relative to the current position of the instance. (The speed is not taken relatively!)

☐ **Speed Horizontal**

The speed of an instance consists of a horizontal part and a vertical part. With this action you can change the horizontal speed. A positive horizontal speed means a motion to the right. A negative one means a motion to the left. The vertical speed will remain the same. Use relative to increase the horizontal speed (or decrease it by providing a negative number).

☐ **Speed Vertical**

In a similar way, with this action you can change the vertical speed of the instance.

☐ **Set Gravity**

With this action you can create gravity for this particular object. You specify a direction (angle between 0 and 360 degrees) and a speed, and in each step this amount of speed in the given direction is added to the current motion of the object instance. Normally you need a very small speed increment (like 0.01). Typically you want a downward direction (270 degrees). If you check the **Relative** box you increase the gravity speed and direction. Note that, contrary to real life, different object can have different gravity directions.

☐ **Reverse Horizontal**

With this action you reverse the horizontal motion of the instance. This can for example be used when the object collides with a vertical wall.

☐ **Reverse Vertical**

With this action you reverse the vertical motion of the instance. This can for example be used when the object collides with a horizontal wall.

☐ **Set Friction**

Friction slows down the instances when they move. You specify the amount of friction. In each step this amount is subtracted from the speed until the speed becomes 0. Normally you want a very small number here (like 0.01).

☐ **Jump to Position**

Using this action you can place the instance in a particular position. You simply specify the x- and y-coordinate, and the instance is placed with its reference point on that position. If you check the **Relative** box, the position is relative to the current position of the instance. This action is often used to continuously move an instance. In each step we increment the position a bit.

☐ **Jump to Start**

This action places the instance back at the position where it was created.

▣ **Jump to Random**

This action moves the instance to a random position in the room. Only positions are chosen where the instance does not intersect any solid instance. You can specify the snapping used. If you specify positive values, the coordinates chosen will be integer multiples of the indicated values. This could for example be used to keep the instance aligned with the cells in your game (if any). You can specify a separate horizontal snapping and vertical snapping.

▣ **Align to Grid**

With this action you can round the position of the instance to a grid. You can indicate both the horizontal and vertical snapping value (that is, the size of the cells of the grid). This can be very useful to make sure that instances stay on a grid.

▣ **Wrap Screen**

With this action you can let an instance wrap around, that is, when it leaves on one side of the room it reappears at the other side. This action is normally used in the **Outside** event. Note that the instance must have a speed for wrapping to work, cause the direction of wrapping is based on the direction of the motion. You can indicate whether to wrap only horizontal, only vertical, or in both directions.

▣ **Move to Contact**

With this action you can move the instance in a given direction until a contact position with an object is reached. If there already is a collision at the current position the instance is not moved. Otherwise, the instance is placed just before a collision occurs. You can specify the direction but also a maximal distance to move. For example, when the instance is falling you can move a maximal distance down until an object is encountered. You can also indicate whether to consider solid object only or all objects. You typically put this action in the collision event to make sure that the instance stops in contact with the other instance involved in the collision.

▣ **Bounce**

When you put this action in the collision event with some object, the instance bounces back from this object in a natural way. If you set the parameter *precise* to false, only horizontal and vertical walls are treated correctly. When you set *precise* to true also slanted (and even curved) walls are treated correctly. This is though slower. Also you can indicate whether to bounce only against solid objects or against all objects. Please realize that the bounce is not completely accurate because this depends on many properties. But in many situations the effect is good enough.

Main actions, set 1

The following set of actions deals with creating, changing, and destroying instances of objects, with sounds, and with rooms.

□ Create Instance

With this action you can create an instance of an object. You specify which object to create and the position for the new instance. If you check the **Relative** box, the position is relative to the position of the current instance. Creating instances during the game is extremely useful. A space ship can create bullets; a bomb can create an explosion, etc. In many games you will have some controller object that from time to time creates monsters or other objects. For the newly created instance the creation event is executed.

□ Create Moving

This action works the same as the action above but with two additional fields. You can now also specify the speed and direction of the newly created instance. Note that if you check the **Relative** box, only the position is relative, not the speed and direction. For example, to make a bullet move in the direction of the person shooting you have to use a little trick. As position use 0,0 and check **Relative**. As direction we need the current direction of the instance. This can be obtained by typing in the word `direction`. (This actually is a variable that always indicates the current direction in which the instance is moving.)

□ Create Random

This action lets you create an instance of one out of four objects. You specify the four objects and the position. An instance of one of these four objects is created at the given position. If you check the **Relative** box, the position is relative to the position of the current instance. If you need a choice out of less than four objects you can use No Object for some of them. This is for example useful to generate a random enemy at a location.

□ Change Instance

With this action you can change the current instance into an instance of another object. So for example, you can change an instance of a bomb into an explosion. All settings, such as the motion and the value of variables, will stay the same. You can indicate whether or not to perform the destroy event for the current object and the creation event for the new object.

□ Destroy Instance

With this action you destroy the current instance. The destroy event for the instance is executed.

□ Destroy at Position

With this action you destroy all instances whose bounding box contains a given position. This is useful, for example, when you use an exploding bomb. When you check the **Relative** box the position is taken relative to the position of the current instance.

□ Change Sprite

Use this action to change the sprite for the instance. You indicate which new sprite. You can also indicate with subimage must be shown. Normally you would use 0 for this (the first subimage) unless you want to see a particular subimage. Use -1 if you do not want to change the current subimage shown. Finally you change the speed of the animation of the subimages. If you only want to see a particular subimage, set the speed to 0. If the speed is larger than one subimages will be skipped. If it is smaller than 1 subimages will be shown multiple times. Don't use a negative speed. Changing sprites is an important feature. For example, often you want to change the sprite of a character depending on the direction in which it walks. This can be achieved by making different sprites for each of the (four) directions. Within the keyboard events for the arrow keys you set the direction of motion and the sprite.

□ Transform Sprite

Use this action to change the size and orientation of the sprite for the instance. Use the scale factors to make it larger or smaller. The angle gives the counter-clockwise orientation of the sprite. For example, to make the sprite oriented in the direction of motion use as a value `direction`. For example, this is useful for a car. You can also indicate whether the sprite should be mirrored horizontally and/or flipped vertically. ***This action is only available in the Standard Edition.***

□ Color Sprite

Normally the sprite is drawn as it is defined. Using this action you can change the color of the sprite. This color is blended with the sprite, that is, it is combined with the colors of the sprite. If you want to draw a sprite in different colors you better define the sprite in black and white and use the blend color to set the actual color. You can also indicate an alpha transparency. With a value of 1 the sprite is opaque. With a value of 0 it is completely transparent. With a value in between you

will partially see the background shine through it. This is great for making explosions. ***This action is only available in the Standard Edition.***

▣ **Play Sound**

With this action you play one of the sound resources you added to your game. You can select the sound you want to play and choose whether it should play only once (the default) or loop continuously. Multiple wave sounds can play at once but only one midi sound can play at a time. So if you start a midi sound, the current midi sound is stopped.

▣ **Stop Sound**

This action stops the indicated sound. If multiple instances of this sound are playing all are stopped.

▣ **Check Sound**

If the indicated sound is playing the next action is performed. Otherwise it is skipped. You can select **Not** to indicate that the next action should be performed if the indicated sound is not playing. For example, you can check whether some background music is playing and, if not, start some new background music. Note that this action returns true when the sound actually plays through the speakers. After you call the action to play a sound it does not immediately reach the speakers so the action might still return false for a while. Similar, when the sound is stopped you still hear it for a while (e.g. because of echo) and the action will still return true.

▣ **Previous Room**

Move to the previous room. You can indicate the type of transition effect between the rooms. You should experiment to see what works best for you. When the rooms do not have the same size you better do not use transitions. If you are in the first room you get an error.

▣ **Next Room**

Move to the next room. You can indicate the transition.

▣ **Restart Room**

The current room is restarted. You indicate the transition effect.

▣ **Different Room**

With this action you can go to a particular room. You indicate the room and the transition effect.

▣ **Check Previous**

This action tests whether the previous room exists. If so, the next action is executed. You normally need this test before moving to the previous room.

▣ **Check Next**

This action tests whether the next room exists. If so, the next action is executed. You normally need this test before moving to the next room.

Main actions, set 2

Here are some more main actions, dealing with timing, giving messages to the user, and dealing with the game as a whole.

▣ **Set Alarm**

With this action you can set one of the twelve alarm clocks for the instance. You select the number of steps and the alarm clock. After the indicated number of steps, the instance will receive the corresponding alarm event. You can also increase or decrease the value by checking the **Relative** box. If you set the alarm clock to a value less than or equal to 0 you switch it off, so the event is not generated.

▣ **Sleep**

With this action you can freeze the scene for a particular time. This is typically used at the beginning or end of a level or when you give the player some message. You specify the number of milliseconds to sleep. Also you can indicate whether the screen should first be redrawn to reflect the most recent situation.

▣ **Display Message**

With this action you can display a message in a dialog box. You simply type in the message. If you use a # symbol in the message text it will be interpreted as a new line character. (Use \# to get the # symbol itself.) If the message text starts with a quote or double quote symbol, it is interpreted as an expression. See below for more information about expressions.

▣ **Show Info**

With this action you pop up the game information window.

▣ **Restart Game**

With this action you restart the game from the beginning.

▣ **End Game**

With this action you end the game.

▣ **Save Game**

With this action you can save the current game status. You specify the filename for saving (the file is created in the working directory for the game). Later the game can be loaded with the next action. (Please realize that only the basic game status is save. Things that are for example not saved are the current sound that is playing, and advanced aspects like the contents of data structures, particles, etc.)

▣ **Load Game**

Load the game status from a file. You specify the file name. Make sure the saved game is for the same game and created with the same version of *GameMaker*. Otherwise an error will occur. (To be precise, the game is loaded at the end of the current step. So some actions after this one are still executed in the current game, not the loaded one!)

Control actions

There are a number of actions with which you can control which other actions are performed. Most of these actions ask a question, for example whether a position is empty. When the answer is yes (true) the next action is executed, otherwise it is skipped. If you want multiple actions to be executed or skipped based on the outcome you can put them in a block by putting start block and end block actions around them. There can also be an else part which is executed when the answer is no. So a question typically looks as follows:

□

Here the question is asked whether a position for the current instance is collision free. If so, the instance starts moving in a given direction. If not, the instance jumps to a given position. Note that the blocks are indented. This gives a better overview of the actions. (In particular when you use blocks inside blocks.) Also it is easier to detect when you forgot a start block or end block action.

For all questions there is a field labeled **NOT**. If you check this field, the result of the question is reversed. That is, if the result was true it becomes false and if it was false, it becomes true. This allows you to perform certain actions when a question is not true.

For many questions you can indicate that they should apply to all instances of a particular object. In this case the result is true only if it is true for all instances of the object. For example, you can check whether for all balls the position slightly to the right is collision free.

The following questions and related actions are available. (Note that they all have a differently shaped icon and a different background color so that they can more easily be distinguished from other actions.)

□ Check Empty

This question returns true if the current instance, placed at the indicated position does not generate a collision with an object. You can specify the position as either absolute or relative. You can also indicate whether only solid, or all objects, should be taken into account. This action is typically used to check whether the instance can move to a particular position.

□ Check Collision

This is the reverse of the previous action. It returns true if there is a collision when the current instance is placed at the given position (again, either only with solid objects or with all objects).

□ Check Object

This question returns true if the instance placed at the indicate position meets an instance of the indicated object.

□ Test Instance Count

You specify an object and a number. If the current number of instances of the object is equal to the number the question returns true. Otherwise it returns false. You can also indicate that the check should be whether the number of instances is smaller than the given value or larger than the given value. This is typically used to check whether all instances of a particular type are gone. This is often the moment to end a level or a game.

□ Test Chance

You specify the number of sides of a dice which is then thrown. Then if the dice lands on one, the result is true and the next action is performed. This can be used to put an element of randomness in your game. For example, in each step you can generate with a particular chance a bomb or a change of direction. The larger the number of sides of the dice, the smaller the chance. You can actually use real numbers. For example if you set the number of sides to 1.5 the next action is performed two out of three times. Using a number smaller than 1 makes no sense.

□ Check Question

You specify a question. A dialog is shown to the player with a yes and a no button. The result is true if the player answers yes.

□ Test Expression

This is the most general question action. You can enter an arbitrary expression. If the expression evaluates to true (that is, a number larger or equal to 0.5) the next action is performed. See below for more information on expressions.

□ Check Mouse

Returns true if the indicated mouse button is pressed. A standard use is in the step event. You can check whether a mouse

button is pressed and, if so, for example move to that position (use the jump to a point action with values `mouse_x` and `mouse_y`).

▣ **Check Grid**

Returns true if the position of the instance lies on a grid. You specify the horizontal and vertical spacing of the grid. This is very useful when certain actions, like making a turn, are only allowed when the instance is on a grid position.

▣ **Start Block**

Indicates the start of a block of actions.

▣ **End Block**

Indicates the end of a block of actions.

▣ **Else**

Behind this action the else part follows, that is executed when the result of the question is false.

▣ **Repeat**

This action is used to repeat the next action (or block of actions) a number of times. You simply indicate the number.

▣ **Exit Event**

When this action is encountered no further actions in this event are executed. This is typically used after a question. For example, when a position is free nothing needs to be done so we exit the event. In this example, the following actions are only executed when there is a collision.

If you want more control over what is happening in the game you can use the built-in programming language that is described in [Part 4](#) of the documentation. It gives you much more flexibility than using the actions. There are also actions to define and test variables. They are simpler to use than code and can be very useful for your games. The following actions deal with this.

▣ **Execute Code**

When you add this action, a form shows in which you can type a piece of code which must be executed. This can contain simple function calls or more complex code. Use the code action preferably only for small pieces of code. For longer pieces you are strongly advised to use scripts which are described in [Part 2](#) of the documentation. Normally when you use this command you will get the rather unhelpful comment "*Execute a piece of code*" inside the actions pane. However, you can change this by adding a three slash (`///`) comment on the first line of the program, and the contents are used as the script description instead.

▣ **Comment**

Use this action to add a line of comment to the action list. The line is shown in italic font. Adding comments helps you remember what your events are doing. The action does not do anything. But realize that it still is an action. So when you place it after a conditional action it is the action that is executed if the condition is true (even though it does not do anything).

▣ **Set Variable**

There are many built-in variables in the game. With this action you can change these. Also you can create your own variables and assign values to them. You specify the name of the variable and the new value. When you check the **Relative** box, the value is added to the current value of the variable. Please note that this can only be done if the variable already has a value assigned to it! See below for more information about variables.

▣ **Test Variable**

With this action you can check what the value of a particular variable is. If the value of the variable is equal to the number provided, the question returns true. Otherwise it returns false. You can also indicate that the check should be whether the value is smaller than the given value or larger than the given value. See below for more information about variables. Actually, you can use this action also to compare two expressions.

▣ **Draw Variable**

With this action you can draw the value of a variable at a particular position on the screen. Note that this can only be used in the draw event of an object.

Azioni di Punteggio

In most games the player will have a certain score. Also many games give the player a number of lives. Finally, often the player has a certain health. The following actions make it easy to deal with the score, lives, and health of the player.

□ Set Score

GameMaker has a built-in score mechanism. The score is normally displayed in the window caption. You can use this action to change the score. You simply provide the new value for the score. Often you want to add something to the score. In this case don't forget to check the **Relative** box.

□ Test Score

With this question action you can check whether the score has reached a particular value. You indicate the value and whether the score should be equal to that value, be smaller than the value or be larger than the value.

□ Draw Score

With this action you can draw the value of the score at a particular position on the screen. You provide the positions and the caption that must be placed in front of the score. The score is drawn in the current font. This action can only be used in the drawing event of an object.

□ Show Highscore

For each game the top ten scores are maintained. This action displays the highscore list. If the current score is among the top ten, the new score is inserted and the player can type his or her name. You can indicate what background image to use, whether the window should have a border, what the color for the new entry and the other entries must be, and which font to use.

□ Clear Highscore

This action clears the highscore table.

□ Set Lives

GameMaker also has a built-in lives system. With this action you can change the number of lives left. Normally you set it to some value like 3 at the beginning of the game and then decrease or increase the number depending on what happens. Don't forget to check the **Relative** box if you want to add or subtract from the number of lives. At the moment the number of lives becomes 0 (or smaller than 0) a "no more lives" event is generated.

□ Test Lives

With this question action you can check whether the number of lives has reached a particular value. You indicate the value and whether the number of lives should be equal to that value, be smaller than the value or be larger than the value.

□ Draw Lives

With this action you can draw the number of lives at a particular position on the screen. You provide the positions and the caption that must be placed in front of the number of lives. The number of lives is drawn in the current font. This action can only be used in the drawing event of an object.

□ Draw Life Images

Rather than drawing the number of lives left as a number, it is often nicer to use a number of small images for this. This action does precisely that. You specify the position and the image and at the indicated position the number of lives is drawn as images. This action can only be used in the drawing event of an object.

□ Set Health

GameMaker has a built-in health mechanism. You can use this action to change the health. A value of 100 is considered full health and 0 is no health at all. You simply provide the new value for the health. Often you want to subtract something from the health. In this case don't forget to check the **Relative** box. When the health becomes smaller or equal to 0 an out of health event is generated.

□ Test Health

With this question action you can check whether the health has reached a particular value. You indicate the value and whether the health should be equal to that value, be smaller than the value or be larger than the value.

□ Draw Health

With this action you can draw the health in the form of a health bar. When the health is 100 the full bar is drawn. When it is 0 the bar is empty. You indicate the position and size of the health bar and the color of the bar and the background.

□ **Score Caption**

Normally in the window caption the name of the room and the score is displayed. With this action you can change this. You can indicate whether or not to show the score, lives, and/or health and what the caption for each of these must be.

Azioni di Disegno

Normally in each step of the game, for each instance, its sprite is drawn in the room. You can change this by putting actions in the draw event. (Note that these are only executed when the instance is visible!) The following drawing actions are available. These actions only make sense in the drawing event. At other places they are basically ignored.

□ Draw Sprite

You specify the sprite, the position (either absolute or relative to the current instance position) and the subimage of the sprite. (The subimages are numbered from 0 upwards.) If you want to draw the current subimage, use number -1.

□ Draw Background

You indicate the background image, the position (absolute or relative) and whether the image should be tiled all over the room or not.

□ Draw Text

You specify the text and the position. A # symbol in the text is interpreted as going to a new line. (Use \# to get the # symbol itself.) So you can create multi-line texts. If the text starts with a quote or a double quote, it is interpreted as an expression. For example, you can use

```
'X: ' + string(x)
```

to display the value of the x-coordinate of the instance. (The variable x stores the current x-coordinate. The function `string()` turns this number into a string. + concatenates the two strings.)

□ Draw Scaled Text

This action is similar to the previous action but this time you can also specify a horizontal and vertical scaling factor to change the size of the text and you can specify an angle to rotate it. ***This action is only available in the Standard Edition.***

□ Draw Rectangle

You specify the coordinates of the two opposite corners of the rectangle; either absolute or relative to the current instance position.

□ Horizontal Gradient

This action also draws a rectangle but this time using a gradient color that changes from left to right. You specify the rectangle and the two colors to use. ***This action is only available in the Standard Edition.***

□ Vertical Gradient

This action also draws a rectangle but this time using a gradient color that changes from top to bottom. You specify the rectangle and the two colors to use. ***This action is only available in the Standard Edition.***

□ Draw Ellipse

This action draws an ellipse. You specify the coordinates of the two opposite corners of the surrounding rectangle; either absolute or relative to the current instance position.

□ Gradient Ellipse

Again an ellipse is drawn but this time you specify a color for the center and the boundary. ***This action is only available in the Standard Edition.***

□ Draw Line

You specify the coordinates of the two endpoints of the line; either absolute or relative to the current instance position.

□ Draw Arrow

Draws an arrow. You specify the coordinates of the two endpoints of the line and the size of the arrow tip.

□ Set Color

Lets you set the color used for drawing shapes, lines, and text. (It does not influence the way sprites and backgrounds are drawn.)

□ Set Full Screen

With this action you can change the screen mode from windowed to fullscreen and back. You can indicate whether to toggle

the mode or whether to go to windowed or fullscreen mode.

□ **Take Snapshot**

With this action you can take a snapshot image of the game and store it in a .png file. You specify the filename to store the image in. ***This action is only available in the Standard Edition.***

□ **Create Effect**

With this action you can create all sorts of effects in a very simple way. You specify the type of effect, e.g. an explosion or smoke, its position, its size and its color and whether it should be shown below the objects or on top of them. For the rest it works automatic. (For rain and snow the position is irrelevant as it always falls down from the top of the screen. To get continuous rain you should create it in each step.) Please note that below actually means at a depth of 100000 and above means at a depth of -100000. ***This action is only available in the Standard Edition.***

Usare le Variabili e le Espressioni

In molte azioni avete bisogno di fornire valori e parametri. Oltre che digitare solo un numero, potete anche digitare una formula, per esempio 32×12 . Ma in realtà potete digitare espressioni più complicate. Per esempio, se volete raddoppiare la velocità orizzontale, potrete settarla a $2 \times \text{hspeed}$. Qui `hspeed` è una variabile che indica la velocità attuale dell'istanza. Ci sono molte altre variabili che potete usare. Alcune delle più importanti sono elencate qui in basso:

x la coordinata-x dell'istanza

y la coordinata-y dell'istanza

hspeed la velocità orizzontale (in pixels per passo)

vspeed la velocità verticale (in pixels per passo)

direction la direzione attuale del movimento espressa in gradi (0-360)

speed la velocità attuale in questa direzione

visible se l'oggetto è visibile (1) o invisibile (0)

image_index questa variabile indica quale sottoimmagine nello sprite attuale è in realtà mostrata. Se volete cambiarla e settare la velocità a 0 (vedere sotto) dovete mostrare una sottoimmagine fissa..

image_speed questa variabile indica la velocità con la quale sono mostrate le sottoimmagini. Il valore di default è 1. Se volete incrementare questo valore di 1 alcune sottoimmagini saranno saltate per rendere l'animazione più veloce. Se volete renderlo inferiore ad 1 l'animazione diventerà più lenta ripetendo le sottoimmagini.

score il valore attuale del punteggio

lives le vite disponibili

health l'energia disponibile (0-100)

mouse_x la posizione-x del mouse

mouse_y la posizione-y del Mouse

Potete cambiare molte di queste variabili usando l'azione di impostazione. Potete anche definire le vostre variabili personali settandole con un valore. (Non usate relative, perché ancora non esiste). Successivamente potete usare queste variabili in espressioni. Le variabili da voi create sono locali all'istanza corrente. Cioè, ogni oggetto ha la sua copia personale delle stesse. Per creare una variabile globale, inserite la parola `global` e un punto davanti ad essa.

Potete anche riferirvi ai valori delle variabili di altro oggetti mettendo il nome dell'oggetto e un punto di fronte a loro. Così, per esempio, se vuoi che una palla si muova nel posto dove sta la moneta, potete settare la posizione su (`coin.x`, `coin.y`). In questo modo nel caso di un evento di collisione potete far riferimento alla coordinata dell'altro oggetto come `other.x`. Nelle condizioni potete fare confronti come `<(più piccolo di); >(più grande di); etc.`

Potete anche usare le funzioni nelle vostre espressioni. Per esempio, la funzione `random(10)` restituisce un numero reale casuale sotto al 10. In questo caso è possibile settare per esempio la velocità o la direzione di un movimento ad un valore a caso. Esistono molte altre funzioni e sono descritte nella [Parte 4](#) della documentazione.

Creare Rooms

Now that you have defined the objects with their behavior in the form of events and actions, it is time to create the rooms or levels in which the game takes place. Any game will need at least one room. In these rooms we place instances of the objects. Once the game starts the first room is shown and the instances in it come to life because of the actions in their creation events.

There are a large number of possibilities when creating rooms. Besides setting a number of properties and adding the instances of the objects you can add backgrounds, define views, and add tiles. Most of these options are discussed later. In this chapter we will only discuss some basic settings, the addition of instances of objects, and the setting of background images.

To create a room, choose **Create Room** from the **Resources** menu. The following form will appear:

□

At the top of the form there is a tool bar. On this you can indicate the size of the grid cells used for aligning objects. Also you can indicate whether or not to show the grid lines and whether or not to show the backgrounds, etc. It is sometimes useful to temporarily hide certain aspects of the room. Realize though that when you are adding instances of objects, these will always be shown, independent of the view setting.) There are also buttons to clear all instances from the room and to shift all instances over a number of pixels. Use negative numbers to shift them left or up. This is useful when for instance you decided to enlarge the room. (You can also use this to place instances outside the room, which is sometimes useful.) There is also the **Undo** button to undo the last change to the room and the **OK** button to save the changes. (Click on the cross at the top right to close the form without saving the changes.)

Finally, the 3 icons at the end, these let you zoom in and out of the room allowing you to zoom in closer, or zoom way out to let you see the whole level. The middle icon will return you to the normal zoom level allowing you to see things at 1:1 resolution. You may find it more useful to use the mouse wheel, rolling it up and down will dynamically change the zoom allowing you to quickly move around the level by zooming out from one area, and in to another. The middle mouse button may also be used to PAN around the level, this is far simpler than using the scroll bars and allows you to view your level easily, at the touch of a button.

At the left you will see three tab pages (five in advanced mode). The object tab is where you add instances of objects to the room. In the **settings** tab you can indicate a number of settings for the room. In the **backgrounds** tab you can set background images for the room.

Adding instances

At the right in the room design form you see the room. At the start it is empty, with a gray background.

□

To add instances to the room, first select the **objects** tab if this one is not already visible. Next select the object you want to add by clicking on the button with the menu icon (or by clicking in the image area at the left). The image of the object appears at the left. (Note that when you changed the origin of the sprite there is a cross in the image. This indicates how the instances will be aligned with the grid.) Now click with your left mouse button in the room area at the right. An instance of the object appears. It will snap to the indicated grid. If you hold the <Alt> key while placing the instance it is not aligned to the grid. If you hold down the mouse button while dragging it over the room, you move the instance to the correct place. If you hold the <Shift> key while pressing and moving the mouse multiple instances are added. With the right mouse button you can remove instances. In this way you define the contents of the room.

As you will notice, if you place an instance on top of another one, the original instance disappears. Normally this is what you want, but not always. This can be avoided by unchecking the box labeled **Delete underlying** at the left.

If you want to change the position of an instance, hold the <Ctrl> key and click with the left mouse button on the instance and hold down the button. You can now drag it to a new position. (Use <Alt> for precise positioning.)

If you hold the <Ctrl> key while clicking with the right mouse button on an instance, a menu appears. Here you can delete the object, type in a precise position for the instance, or move the bottommost instance at the position to the top or send the

topmost instance to the bottom.

Room setting

Each room has a number of settings that you can change by clicking on the **settings** tab.

□

Each room has a name. Best give it a meaningful name. There also is a caption. This caption is displayed in the window caption when the game is running. You can set the width and height of the room (in pixels). Also you can set the speed of the game. This is the number of steps per second. The higher the speed, the smoother the motion is. But you will need a faster computer to run it.

Setting the background

With the tab **backgrounds** you can set the background image for the room. Actually, you can specify multiple backgrounds. The tab page looks as follows:

□

At the top you will see the background color. You can click on it to change it. The background color is only useful if you don't use a background image that covers the whole room. Otherwise, best uncheck the box labeled **Draw background color** because this will be a waste of time.

At the top you see a list of 8 backgrounds. You can define each of them but most of the time you will need just one or two. To define a background, first select it in the list. Next check the box labeled **Visible when room starts** otherwise you won't see it. The name of the background will become bold when it is defined. Now indicate a background image in the menu. There are a number of settings you can change. First of all you can indicate whether the background image should tile the room horizontally and/or vertically. You can also indicate the position of the background in the room (this will also influence the tiling). A different option is to stretch the background. The background will then be scaled so that it fills the entire room. The aspect ratio of the image will not be maintained. Finally you can make the background scrolling by giving it a horizontal or vertical speed (pixels per step). Better not use scrolling with a stretched background. The result will be a bit jaggy.

There is one more checkbox labeled **Foreground image**. When you check this box, the background is actually a foreground, which is drawn on top of everything else rather than behind it. Clearly such an image should be partially transparent to be of any use.

Distributing your game

With the information in the preceding chapters you can create your games. When your game is finished you obviously want other people to play it. You can of course give them the .gm81 file that you created and let them use *GameMaker* to play it but this is normally not what you want. First of all, you don't want others to be able to change the game, and secondly you also want people to play the game even if they do not have *GameMaker*. So you would like to create a stand-alone executable of your game.

Creating stand-alone executables is very easy in *GameMaker*. In the **File** menu you select the item **Create Executable**. You will be asked for the name of the executable that should contain the game. Indicate a name, press **OK** and you have your stand-alone game that you can give to anyone you like. You can change the icon for the stand-alone game in the **Global Game Settings**. See [Part 3](#) for details.

Once you have created a stand-alone executable in the way described above you can give this file to other people or place it on your website to download. You are free to distribute the games you create with *GameMaker* in any way you like. You can even sell them. This of course assumes that the sprites, images, and sounds you use can be distributed or sold as well. See the enclosed license agreement for more information.

It is normally useful to zip your executable, together with some readme information. In Windows XP and later this can be done directly through the right mouse button menu, and there are many free zip utilities available on the web. Alternatively you can create an installer for your game. Again, a large number of free installation creation programs are available on the web.

If you want your game to be played by many more people we recommend you to upload it to the [YoYo Games website](#) and press on the Share button at the top.

Uso Avanzato

Questa sezione serve per darti piÃ¹ informazioni sugli aspetti avanzati di *GameMaker*.

Informazioni degli usi avanzati di *GameMaker* possono essere trovate seguenti pagine:

- [Interfaccia Utente Avanzata](#)
- [Di piÃ¹ sugli Sprite](#)
- [Di piÃ¹ sui Suoni e la Musica](#)
- [Di piÃ¹ sui Background](#)
- [Di piÃ¹ sugli Objects](#)
- [PiÃ¹ Azioni](#)
- [Costanti](#)
- [Eventi Trigger](#)
- [Including Files](#)
- [Di piÃ¹ sulle Rooms](#)
- [Fonts](#)
- [Paths](#)
- [Time Lines](#)
- [Scripts](#)
- [Extension Packages](#)
- [Esportare e Importare Risorse](#)

Advanced mode

Up to now we have only considered the simple features of *GameMaker*. But there are a lot more possibilities. To be able to use these you must run *GameMaker* in advanced mode. This is easy to change. In the **File** menu, click on the menu item **Advanced mode**. (To fully see the effects you should restart *GameMaker* or at least save your game and load it anew.)

When you start *GameMaker* in advanced mode, the following form is shown:

□

It contains all that was there in simple mode, but there are a number of additional resources, buttons, and menu items. Also, as we will see in the chapters that follow, the different resources have additional options. Here we will discuss the additional menu items.

File menu

In the file menu you can find the following additional commands:

- **Publish your Game.** This command will take you to our website where you can easily upload and publish your finished game such that everybody can play it. Carefully follow the instructions to make your game available. Please only use this for finished games, not for preliminary versions. ***This possibility is only available in the Standard Edition.***
- **Import Resources.** With this command you can import resources that you exported with the next command. See the section on [Esportare e Importare Risorse](#) for more details.
- **Export Resources.** With this command you can export resources to a file. See the section on [Esportare e Importare Risorse](#) for more details.
- **Preferences.** Here you can set a number of preferences about *GameMaker*. They will be remembered between different calls of *GameMaker*. For more information see the page on [Preferences](#).

Edit menu

In the edit menu you can find the following additional commands:

- **Add group.** Resources can be grouped together. This is very useful when you make large games. For example, you can put all sounds related to a certain object in a group, or you can group all objects that are used in a particular level. This command creates a new group in the currently selected resource type. You will be asked for a name. Groups can again contain groups, etc. You can drag resources into the groups.
- **Find Resource.** With this command you type in the name of a resource and it opens the corresponding property form.
- **Expand Resource Tree.** Fully expands the resource tree, showing all resources.
- **Collapse Resource Tree.** Fully collapses the resource tree, hiding all resources.
- **Show Object Information.** Using this command you can get an overview of all objects in the game.

Resources menu

In this menu you can now also create the additional resources. Note that for each of them there is also a button on the toolbar and a keyboard shortcut. There are three special menu items at the bottom:

- **Define Constants.** Here you can define constants for use in your scripts and action arguments. For more information see the section on [Constants](#).
- **Define Triggers.** Here you can define your own trigger events. For more information see the section on [Eventi Trigger](#).
- **Included Files.** Here you can indicate which additional files should be included in the game executable. For more information see the section on [Including Files](#).

Scripts menu

In the scripts menu you can find the following additional commands:

- **Import Scripts.** Can be used to import useful scripts from files.
- **Export Scripts.** Can be used to save your scripts in a file, to be used by others. When you select a script resource only this script is saved. When you select a group all scripts in the group are saved. When you select the root resource (or a different type of resource) all scripts are saved. This menu item is also available when right-clicking on a script or group of scripts.
- **Show Built-in Variables.** Shows a sorted list of all built-in variables, both local and global.
- **Show Built-in Functions.** Shows a sorted list of all built-in functions.
- **Show Extension Functions.** Shows a sorted list of all functions available in the extension packages you included in your game.
- **Show Constants.** Shows a sorted list of all built-in constants and constants defined in the game options.
- **Show Resource Names.** Shows a sorted list of all resource names. You can click on a name to open the particular resource for editing.
- **Search in Scripts.** You can search for a string in all scripts. You can click on one of the reported places to move there for editing.
- **Check Resource Names.** Does a check of all resource names. Names will be reported if they are not correct, if there are duplicate resource names, or when a resource name is the name of a variable, function, or constant. You can click on a name to open the particular resource for editing.
- **Check All Scripts.** Checks all scripts for errors. You can click on one of the reported places to move there for editing.

Help menu

Here you can now also find help information about the extension packages you are using.

Preferences

Under the **Preferences** menu item in the **File** menu you can set a number of preferences that will be maintained between runs of *GameMaker*. The following preferences can be set:

General tab

□

- **Show recently edited games in the file menu.** If checked the eight most recently edited games are shown under the recent files in the file menu.
- **Load last opened file on startup.** If checked when you start *GameMaker* the most recently opened file is opened automatically.
- **Keep backup copies of files.** If checked the program saves a backup copy of your game with the extension gb0-gb9. You can open these games in *GameMaker*. You are strongly advised to use at least one backup copy for your work!
- **Maximum number of backups.** Here you can indicate how many (1-9) different backup copies should be remembered by the program.
- **Show progress while loading and saving files.** If checked, when load or save a file a progress indicator is shown.
- **At startup check for, and remove old temporary files.** *GameMaker* and games created with it, create temporary files. Normally these are automatically removed but sometimes, for example when games crash, they are left behind. If this option is checked, *GameMaker* checks whether such files exist and removes them at startup.
- **Don't show the website in the main window.** When checked the image and link to the website on the main window are not shown.
- **Hide the designer and wait while the game is running.** When checked the game making program is hidden while you are testing a game.
- **Run games in secure mode.** If checked, any game created with *GameMaker* that runs on your machine will not be allowed to execute external programs or change or delete files at a place different from the game location. (This is a safeguard against Trojan horses although success is not guaranteed.) Checking this means that games that utilizes external files etc. won't be running correctly. The setting only works while *GameMaker* is running. So if you run the game independently of *GameMaker*, for example as an executable stand-alone, it is NOT run in secure mode.
- **Show news on startup.** Whether to show the *GameMaker* news once a day when the program is started. (Cannot be changed in the Lite Edition.)
- **Show news in default browser.** Whether to show the *GameMaker* news in your default Internet browser, rather than in the program itself. (Cannot be changed in the Lite Edition.)
- **Location of GameMaker TV style Logo.** In the Lite version a small logo will appear in a corner of the game play area when you create a standalone executable. This lets you pick the corner.

Forms tab

□

Sprite Form

- **Show the origin in the sprite image.** If checked, in the sprite properties form, in the sprite image, the origin for the sprite is indicated.

Object form

- **In object properties, show hints for actions.** If checked, in the object properties form, when you hold your mouse over one of the actions, a description is shown.
- **Default Tab to select.** This allows you pick the default action tab when opening the object window. This is handy if you only ever use the code action as by selection tab 4, it saves you having to pick it every time. This option also works for Timelines...

Room Form

- **When closing, remove instances outside the room.** If checked, the program warns you when there are instances or tiles outside a room and lets you remove them.
- **Remember room settings when closing the form.** If checked, a number of room settings, like whether to show the grid, whether to delete underlying objects, etc. are remembered when you edit the same room later.
- **Room Grid ON by default.** This a. This allows you to disable the room grid each time a new room is opened or created.
- **Fill room with colour when no background colour selected.** If you create a room and don't give it a *fill* colour it will normally fill it with the user definable default colour. If you untick this box then you will see the default user defineable grid through the room. This can sometimes be useful to help visualise a level.

Scripts and code tab

□

These settings relate to the built-in script and code editor. Most of these settings are explained in detail in the page on [Scripts](#). Here we just give a short overview:

- **Group undo operations** When grouped multiple actions (like typing a whole line) becomes one operation for undo.
- **Number of undo** You can change this number but in general this should be fine.
- **Automatic indentation** When set Enter and Backspace keys cleverly deal with indents.
- **Indent amount** How much to indent with each tab.
- **Smart tabs** When set tabs go to the position below the first non-empty space in the previous line.
- **Allow cursor beyond end of line** When checked you can place the cursor at any position in the editor screen, also beyond the end of line. If unchecked this is not possible. This also changes the behavior of the left and right arrow keys.
- **Show auto-completion options** When set help is given on which functions and variables start with the letters you are typing.
- **Dealy (msec)** The delay in milliseconds before the help is shown. Set e.g. to 0 for immediate.
- **Show function argument help** When set, when typing function arguments, in the statusbar help about this is provided.
- **Show find string** When set, whenever typing in a find string, all locations are shown in the code.
- **Show line numbers** Whether the editor should display the line numbers.
- **Show matching brackets** Whether the editor should indicate matching open en close brackets.
- **Show code snippets with F2** When set, pressing F2 will bring up a number of useful code snippets.
- **Check code while typing** When set the code is constantly checked and errors reported.
- **Enable BOLD on script keywords** Allows you to have all script keywords in BOLD. Please select a FONT where the width of the BOLD string, is the same as the width of the NON-BOLD string.
- **Use color coding** Whether to use color coding in the editor.
- **Colors** Here you can set the colors used for color coding. You can also reset the default colors.
- **Font** Here you can select the font for the editor. Note that only fixed pitch fonts are shown. Also note that only the font and the size are used.

Editors

□

Here you can choose whether to use the built-in code editor (highly recommended) or an external editor. In the case of an external editor, the script text is saved as a .txt file and the editor is called with this file as an argument. After editing it you should save the file and close the editor such that *GameMaker* can read the file back in.

Also you can choose whether to use the built-in image editor (highly recommended) or an external editor. In the case of an external editor, the image is saved as a .png file and the editor is called with this file as an argument. After editing it you should save the file and close the editor such that *GameMaker* can read the file back in.

Finally you can indicate the different external editors for the sound files you want to use. *GameMaker* does not contain internal sound editors. There are three possible editors handling .wav, .mid and .mp3 files. In the case of an external editor, the sound is saved as a .wav, .mid, or .mp3 file and the corresponding editor is called with this file as an argument. After editing it you should save the file and close the editor such that *GameMaker* can read the file back in.

Other Settings

It is also possible to change the location of the temp files that *GameMaker* creates to e.g. store the game that is tested. This location cannot be changed from the Preferences but is changes by creating a file `tempdir.txt` in the folder where *GameMaker* is located. In this file there should be one line containing the location of the folder in which the temp files are creates, for example `C:\GMTEMP`. Note that the name must include the complete path and should **not** end with a backslash. Each time *GameMaker* is run a unique temporary folder is created within this location. So things will work out fine, even when multiple instances of *GameMaker* use the same location. (Note that the games themselves also create a temp folder for their files. Again, this can be changed by creating a file `tempdir.txt` and placing it in the folder where the game executable is located.)

Secondly, it is possible to change the image *GameMaker* is using for the background of its main form. To this end place an image file `back.bmp` in the folder where *GameMaker* is located.

Di più¹ sugli Sprite

When running *GameMaker* in advanced mode the A number of advanced options exist. When you open the sprite form it will look as follows:

□

A new button **Save Sprite** has appeared. With this button you can save the sprite in a proprietary format. This format will not only store the image(s) of the sprite but also other settings, such as collision settings and the origin. The file will have the extension `.gmspr`. *GameMaker* can load such files but also the games can load them.

At the bottom-left, you can indicate the origin of the sprite. This is the point in the sprite that corresponds with its position in the room. When you set an instance at a particular position, the origin of the sprite is placed there. Default it is the top left corner of the sprite but it is sometimes more convenient to use the center (by clicking the **Center** button) or some other important point. You can even choose an origin outside the sprite. You can also set the origin by clicking in the sprite image. The origin will be shown with a cross.

Most important are the options related to collision checking. Whenever two instances meet a collision event is generated. Collisions are checked in the following way. Each sprite has a mask. Default this corresponds to all pixels that are not fully transparent. When two pixels in the masks of the two sprites overlap, a collision is reported.

Sometimes you don't want precise collision checking. In this case, uncheck the box **Precise collision checking**. Now the bounding box is used as the mask.

When the sprites has multiple subimages, default there is just a single mask that combines the masks of all subimages. Normally this is what you want but in certain situations you might want each subimage to have its own mask. In this case check the box **Separate collision masks**.

Collision Masks

If you want even more control over the collision masks, press the button **Modify Mask**. The following window will show:

□

At the left top there is again the information about the sprite image. You can show the different subimages. Also you can indicate here whether to show the collision mask (default on). In this case, in the images at the right the mask is shown in dark. You can also zoom in and out to get a better view.

To the right of this you can change the bounding box. Only pixels inside this bounding box are used for the mask. Default the bounding box is automatically computed, taking the alpha tolerance into account, separate for each subimage, when using separate collision masks. You can also set it to the full image or you can set it to manual. In the latter case you can specify the bounding box yourself. When set to manual you can also draw the bounding box with the left mouse button in the image, or you can move it with the right mouse button. (Note though that the mask is shown while drawing, not the bounding box!)

Below this you can indicate the shape of the mask. Default is precise, pixel-wise collision checking, but you can select here also to use the bounding rectangle, a disk (or ellipse) inside it, or a diamond shape. Rectangles or disks are in many cases better representations of the shape. (Note that the choice has no effect on speed!)

Finally, at the left bottom you can (again) indicate whether or not there should be separate collision masks for all subimages. (Note that if you set the bounding box manual, a single bounding box will be used for all subimages, regardless of this setting.) You can also indicate the tolerance with respect to the transparency. With a higher tolerance also pixels that are partially transparent are left outside the mask. This influences both the bounding box (when not set to manual) and the mask for precise collision checking.

It is important to carefully decide on the collision mask you use for your sprites. Although precise collision checking might seem the most logical option, in many cases game play is improved by using bounding boxes or disks, or masks that are a bit smaller than the actual sprites. If you want even further control over the mask, note that for objects you can specify a different sprite to use as mask. In this way you can make the collision mask completely independent of the image.

Once you are done, press **OK**. If the mask was modified, the word **Modified** will show in the sprite form such that you are

reminded that you changed some settings here.

Editing Sprites

GameMaker has extensive possibilities to create and change your own sprites. Information about this can be found in the following pages:

[Editing your sprites](#)

[Strips](#)

[Editing individual subimages](#)

Editing your sprites

Up to now we loaded our sprites from files. It is though also possible to create and in particular modify them within *GameMaker*. To do this, open the sprite property window by double clicking on one of your sprites (or by creating a new one). Now press the button labeled **Edit Sprite**. A new form will appear showing all the subimages that make up the sprite.

The sprite editor form will look as follows:

□

At the right you see the different images that make up the sprite. Note that in *GameMaker* all subimages of a sprite must have the same size. At the left an animation of the sprite plays. (If you don't see the animation, check the box labeled **Show Preview**.) Below the preview you can change the speed of the animation and the background color. Also you can select one of the backgrounds in your game and whether it must be stretched. In this way you can get an idea of what the animation will look like in the game. (Note that this speed is only for preview. The speed of the animation during the game depends on the room speed.)

The sprite editor contains many commands to create and change the sprite. These are all given through the menus. (For some there are buttons on the toolbar.) Some commands work on individual images. They require that you first select a subimage with the mouse.

File menu

The file menu contains a number of commands related to loading and saving sprites.

- **New**. Creates a new, empty sprite. You must indicate the size of the sprite. (Remember, all images in a sprite must have the same size.)
- **Create from File**. Creates the sprite from a file. Many file types can be used. They all create a sprite consisting of a single image, except for animated GIF files that are split into the subimages and strips that have a name ending with `_stripXX`. When selecting a file you can indicate whether the image should be opaque, whether to remove the background, and whether to smooth the edge. You can select multiple images which will then all be loaded. They should preferably have the same size, otherwise, their canvas sizes will be adapted.
- **Add from File**. Adds an image (or multiple images) from a file to the current sprite. If the images do not have the same size you can choose where to place them or to stretch them. You can select multiple images which will then all be loaded. They must preferably have the same size.
- **Save as PNG File**. Saves the sprite as a strip in a PNG file. When the sprite has multiple subimages the text `_stripXX` with XX the number of subimages is automatically appended.
- **Create from Strip**. Allows you to create a sprite from a strip. See the next section for more information.
- **Add from Strip**. Use this to add images from a strip. See the next section.
- **Close Saving Changes**. Closes the form, saving the changes made to the sprite. If you don't want to save the changes, click on the close button of the form.

Edit menu

The edit menu contains the following commands:

- **Undo**. Undo the last change. The last 16 changes can be undone.
- **Redo**. Redo the last undone change.
- **Cut**. Cut the currently selected subimage to the clipboard. You can edit or use the subimage in a different program this way. However, the transparency information might be lost.
- **Copy**. Copy the currently selected subimage to the clipboard.
- **Paste**. Paste the image on the clipboard as a new subimage. When it has not the correct size you should indicate how to change this. When the image came from a different program, transparency information might be lost.
- **Erase**. Erase the current, or all images to a particular color. A form open in which you can select the color and the opacity (alpha) value. A preview of the result is shown. You can indicate whether to erase all images or only the current one.

- **Delete.** Delete the currently selected subimage.
- **Move Left.** Move the currently selected subimage one position to the left in the sequence.
- **Move Right.** Move the currently selected subimage one position to the right in the sequence.
- **Add Empty.** Add a new empty subimage at the end of the sequence.
- **Insert Empty.** Insert a new empty subimage before the currently selected subimage.
- **Edit.** Edit the currently selected subimage using the built-in image editor.
- **Set Transparency Background.** Here you can indicate how the transparent area of the sprites should be shown in the sprite editor. You can either use a customizable block pattern, or a color that you can change by clicking on the color box.

Transform menu

In the transform menu you can perform a number of transformations on the images. For most of them you can choose whether to apply them only to the current sub image or to all images.

- **Shift.** Here you can shift the image(s) an indicated amount horizontally and vertically.
- **Mirror/Flip.** Mirror the image(s) horizontally and/or flip them vertically.
- **Rotate.** You can rotate the image(s) 90, 180 or 270 degrees, or an arbitrary amount.
- **Scale.** This command scales the image(s) (but not the image size!). You can indicate the scale factor and whether to scale horizontally and/or vertically.
- **Skew.** This command skews the image(s) horizontally and/or vertically with a given amount.
- **Resize Canvas.** Here you can change the size of the canvas. You can also indicate where the images are placed on the new canvas.
- **Stretch.** Here you can stretch the images into a new size. You can indicate the scale factor and the quality.
- **Crop.** This makes the images as small as possible. This is very useful because the larger the images, the more video memory *GameMaker* will use. You can indicate the size of a transparent border around the images. If you provide a negative value, the outside of the images will be cut off.

Images menu

In the images menu you can perform a number of operation on the images. Some of these are only available in the Standard Edition.

- **Cycle Left.** Cycles all images one place to the left. This effectively starts the animation at a different point.
- **Cycle Right.** Cycles all images one place to the right.
- **Black and White.** Makes the image(s) black and white (that is, grayscale).
- **Colorize.** Here you can change the color (hue) of the images. Use the slider to pick the new hue. When you indicate to shift the hue the colors are shifted over the amount indicated giving rather interesting effects.
- **Colorize Partial.** Here you can change the color (hue) of part of the images. You can select the old hue and a tolerance around it and then indicate the new hue with which to replace this range of colors. This can be used for instance to change only the color of the shirts of players. You can pick the old hue also by clicking in the left image.
- **Intensity.** Here you can change the intensity by providing values for the color saturation and the value of the new images.
- **Invert.** Inverts the colors in the images.
- **Make Opaque.** Remove all transparency information from the images, making them opaque.
- **Erase a Color.** You can select a color (either by clicking on the color box or by clicking in the left image. Also you specify a tolerance. All pixels with a color close the the selected color will be made transparent.
- **Smooth Edges.** Smooth the edges around the opaque part of the image(s) somewhat to make them look nicer. (A stronger effect can be created by using Blur but only blurring the transparency; see below.
- **Opacity.** Here you can change the opacity (transparency) for the whole image. You can either set it relative to the current opacity or absolute. (Fully transparent pixels always stay fully transparent.)
- **Set Alpha from File.** You select an image. The lightness of the pixels of that image will be used as transparency value. Black pixels will lead to completely transparent pixels, while white pixels will lead to opaque pixels. When the image does not have the correct size it will be stretched. **Only available in the Standard Edition.**
- **Fade.** Here you specify a color and an amount. The pixels in the image(s) are now faded towards this color with the given amount.

- **Blur.** By blurring the images the colors are mixed a bit, making it more vague. You can select a small, medium, or large blur. Also you can select whether to blur the color values and/or the transparency values. Only blurring the transparency values is a nice way to smooth the boundary of the images.
- **Sharpen.** This is sort of the reverse of blurring. The image will be made more sharp, enhancing the edges. You can do a subtle sharpening or a strong sharpening. The special sharpening puts additional emphasis on the edges, leading to a funny effect. You can sharpen the color values and/or the transparency values.
- **Outline.** Create an outline around the image. You are asked for the color and a thickness of the outline. You can also indicate to place the outline inside the image. You can indicate whether to remove the image itself, just keeping the outline, and whether to smooth the outline. **Only available in the Standard Edition.**
- **Shadow.** Create a shadow behind the image. (This will only work when the image is partially transparent.) You indicate the color of the shadow and the opacity. Also you indicate the relative position of the shadow. Finally you can indicate whether it should be a soft or a hard shadow. **Only available in the Standard Edition.**
- **Glow.** Create a colored glow around the image. You indicate the color of the glow, the opacity and the thickness. You can also indicate to place the glow inside the image. **Only available in the Standard Edition.**
- **Buttonize.** Turn the image(s) into a button. You specify the color of the button and the opacity. Also you must indicate the thickness of the button boundary and whether it should be smooth or not. **Only available in the Standard Edition.**
- **Gradient Fill.** Adds a gradient fill to the image(s). You specify the two colors of the fill, the opacity, and the kind of fill. Default the image is replaced by the gradient although the transparency is maintained. By unchecking the Replace box the gradient is blended onto the image. By checking the Change Transparency box the alpha value of the original image is changed as well. You can create great effects. For example, make an image black-and-white and then blend a gradient on it. **Only available in the Standard Edition.**

You will have to experiment with these commands to get the sprites you want.

Animation menu

Under the animation menu you can create new animated sprites out of the current sprite. There are many options and you should experiment a bit with them to create the effects you want. Also don't forget that you can always save an animated sprite and later add it to the current one. Also you can always add some empty images and delete unwanted ones. We will briefly go through the different possibilities.

- **Set Length.** Here you can change the length of your animation. The animation is repeated enough times to create the number of frames you indicate. (Normally you want this to be a multiple of the current number of frames.)
- **Stretch.** This command also changes the length of the animation. But this time, frames are duplicated or removed to get the right number. So if you increase the number of frames the animation goes slower and if you decrease the number it goes faster.
- **Reverse.** Well, as you could guess this reverses the animation. So it is played backwards.
- **Add Reverse.** This time the reverse sequence is added, doubling the number of frames. This is very useful for making an object go left and right, change color and return, etc. You sometimes might want to remove the double first and middle frame that occur.
- **Translation Sequence.** You can create an animation in which the image slightly translates in each step. You must provide the number of frames and the total amount to move horizontally and vertically.
- **Rotation Sequence.** Creates an animation in which the image rotates. You can either choose clockwise or counterclockwise rotation. Specify the number of frames and the total angle in degrees (360 is a complete turn). (You might need to resize the canvas first to make sure the total image remains visible during the rotation.)
- **Colorize.** Creates an animation that turns the image into a particular color.
- **Fade to color.** Creates an animation that fades the image to a particular color.
- **Disappear.** Makes the image disappear by making it more transparent in each step.
- **Shrink.** Shrinks the image to nothing. You can indicate the direction.
- **Grow.** Grows the image from nothing.
- **Flatten.** Flattens the image to nothing in a given direction.
- **Raise.** Raises the image from a given direction.
- **Overlay.** Overlays the animation with another sprite or image in a file. You indicate the file and the image(s) from that file are then placed on top of the current animation. When the image from the file has a different size it is stretched.
- **Morph.** Morphs the animation to an animation or image from a file. Note that morphing works best if the two animations cover the same area of the image. Otherwise, halfway certain pixels disappear and others suddenly

appear.

In particular the last two commands are very powerful. For example, to blow up an object, add a number of copies and then a number of empty frames. Then overlay it with an explosion animation. (Make sure the numbers of images match.) Alternatively, morph it to the explosion. With some practice you can make great sprites.

Strips

As indicated above, sprites are normally either stored as animated gif files or as strips in PNG files, in which all subimages are placed next to each other. In the second case the file name should end with `_stripXX` where XX indicates the number of subimages.

However, sometimes sprites are part of a larger bitmap in which the sub images can be stored next to each other or below each other and maybe there are separating lines between them. Such a strip cannot be read automatically as *GameMaker* will not know the size and position of the subimage. For example, the following piece of a strip file contains four different animations.

□

If you want to pick a certain animation out of such a file you must indicate where the images are. To this end you can choose **Create from Strip** or **Add from Strip** from the **File** menu in the sprite editor. After indicating the appropriate strip image file, the following form will show:

□

At the right you see (part of) the strip image you selected. At the left you can specify a number of parameters that specify which subimages you are interested in. Note that one or more rectangles in the image indicate the images you are selecting. The following parameters can be specified:

- **Number of images.** This is the number of sub images you want to take from the strip.
- **Images per row.** How many images of the ones you want are there per row. For example, by setting this to 1 you will select a vertical sequence of images.
- **Image width.** Width of the individual images.
- **Image height.** Height of the individual images.
- **Horizontal cell offset.** If you don't want to select the top-left images, you can set here how many images should be skipped horizontally.
- **Vertical cell offset.** Here you indicate how many images to skip vertically.
- **Horizontal pixel offset.** Sometimes there is some additional space at the left top. Here you indicate this amount (in pixels). You can also use the mouse to indicate the place where the first image should start
- **Vertical pixel offset.** Vertical amount of extra space.
- **Horizontal separation.** In some strips there are lines or empty space between the images. Here you can indicate the horizontal amount to skip between the images (in pixels).
- **Vertical separation.** Vertical amount to skip between the images.

Once you selected the correct set of images, press **OK** to create your sprite. Please remember that you are only allowed to use images created by others when you have their permission or when they are freeware.

Editing individual images

GameMaker has a built-in image editor that can be used to edit individual subimages of sprites and background images. To call the editor for a subimage of a sprite, select the subimage in the sprite editor and choose **Edit Image** from the **Image** menu (or double click on it). To edit a background, open the background properties for and press the button **Edit Background**.

The built-in image editor is pretty powerful and especially suited for creating sprites and backgrounds for *GameMaker*. However, it does not have all the features of full-blown paint and drawing packages. The built-in editor is primarily meant for making changes to images, not for creating sprites and backgrounds from scratch. For this you probably want to use a separate paint program, save the images as PNG files, and load them into *GameMaker*. You can also set an external image editor in the preferences.

When you start the image editor it will typically look as follows:

□

The form shows the image in the middle and a number of drawing tools at the left. Below there you can set certain properties of the drawing tools. These will change depending on the tool you select (see below). In the middle you see the current image. You can zoom in and out using the buttons on the toolbar. At the right there is information about the colors with which the draw. You can set a separate color for the left and the right mouse button. You can change these by clicking with the left or right mouse button in the color selector images. Also you can change them by clicking in the boxes at the top that represent the colors. Below the colors you see the Opacity. This indicates how opaque or transparent the color is. When you set it to 255 the pixels your draw are fully opaque. When you set it to 0 they are fully transparent. Normally when you draw partially transparent pixels they are blended with the current color. By setting the Color Mode to Replace, the pixels will be replaced with the new color. Finally at the bottom of the form there is a statusbar with some information about the current drawing tool, the position of the mouse, the size of the image, and the amount of memory it requires.

Drawing tools

The following drawing tools are available (from left to right, top to bottom).

- **Paint.** With this tool you can paint on the image. You can use the left or right mouse button to paint in the different colors. You can select the size of the pen. When holding <Shift> when starting to paint you only paint horizontal or vertical lines. When holding the <Ctrl> key you can select a new paint color.
- **Spray.** With this tool you can spray on the image. Spray is like paint except that you use a brush that is partially transparent at the sides. You can use the left or right mouse button to paint in the different colors. You can select the size of the brush. You can also select the hardness of the brush. A soft brush will be more transparent near the sides. When holding <Shift> when starting to spray you only paint horizontal or vertical lines. When holding the <Ctrl> key you can select a new spray color.
- **Erase.** With this tool you can erase part of the image. It looks a lot like spray but you erase what is below the mouse. How much you erase depends on the Opacity. For a value of 255 you erase completely. For a smaller value you only make the image a bit more transparent. You can set the hardness of the eraser. When holding <Shift> when starting to spray you only paint horizontal or vertical lines.
- **Color Picker.** With this tool you can set the left or right mouse color to the color of a pixel in the image. Note that also the opacity value is set.
- **Line.** With this tool you can draw straight lines. When holding <Shift> you can draw horizontal, vertical, or diagonal lines. You can set the width of the line and whether it should have arrows. By selecting **Anti-alias** the line is drawn with partially transparent pixels on the side to make it more smooth.
- **Polygon.** With this tool you can draw a closed polygon. You click on the position of the first vertex. Next you can either drag the next vertex or click on the position of the next vertex. In this way you continue. You end the polygon with the <Esc> key. When holding <Shift> you can draw horizontal, vertical, or diagonal lines. You can set the width of the line and whether the polygon should be filled or not. By selecting **Anti-alias** the polygon is drawn with partially transparent pixels on the side to make it more smooth.
- **Rectangle.** With this tool you can draw a rectangle. When holding <Shift> you can draw a square. When holding <Ctrl> you draw the rectangle from the center. You can set the width of the line and whether the rectangle should be filled or not. By selecting **Anti-alias** the rectangle is drawn with partially transparent pixels on the side to make it more smooth.

- **Ellipse.** With this tool you can draw an ellipse. When holding <Shift> you can draw a circle. When holding <Ctrl> you draw the ellipse from the center. You can set the width of the line and whether the ellipse should be filled or not. By selecting **Anti-alias** the ellipse is drawn with partially transparent pixels on the side to make it more smooth.
- **Rounded Rectangle.** With this tool you can draw a rounded rectangle. When holding <Shift> you can draw a square. When holding <Ctrl> you draw the rounded rectangle from the center. You can set the width of the line and whether the rounded rectangle should be filled or not. By selecting **Anti-alias** the rounded rectangle is drawn with partially transparent pixels on the side to make it more smooth.
- **Select Region.** With this tool you can select a rectangular region. You can extend the current selection by holding the <Shift> key. Also you can remove parts by holding the <Ctrl> key. Once you made a selection you can pick it up with the mouse and drag it to a new position. When you use the right mouse button you make a copy. The selection can also be cut or copied to the clipboard. It can be deleted with the key. You can end the selection using the <Esc> key.
- **Select with Magic Wand.** In this case you make the selection by clicking on a pixel. All connected pixels with the same color will be selected. You can indicate the tolerance in color value with which to select pixels and whether only the color or also the transparency value should match. You can extend the current selection by holding the <Shift> key. Also you can remove parts by holding the <Ctrl> key. You can manipulate the selection as above.
- **Select by Spraying.** In this case you make the selection by spraying with the mouse on the image. You can set the size of the selector. For the rest the selection can be treated as above. Different selection types can be combined.
- **Text.** To add a text click on the image. A pop-up window appears in which you can enter the text. Use the # symbol to insert a newline. Once you press **OK** the text is put in the image, with a box around it. You can now move the text by pressing with the mouse in the box and dragging the text. You can change the text by clicking with the right mouse button in the box. You can set the Font of the text and how the different lines should be aligned.
- **Fill.** Click on a pixel in the image and all connected pixels with the same color will be turned into the new pixel. You can set the tolerance with which the color should match. Also you can set whether to only match on the color value or also take the transparency value into account. Note that when the Color Mode is set to Blend the fill color is blended with the existing one. To replace it, set the Color Mode to Replace.
- **Change Color.** Click on a pixel in the image and all pixels in the image with the same color will be turned into the new pixel. You can set the tolerance with which the color should match. Also you can set whether to only match on the color value or also take the transparency value into account. Note that when the Color Mode is set to Blend the new color is blended with the existing one. To replace it, set the Color Mode to Replace.

Menus

A number of further commands is available through the menus. For some of these there is a corresponding button on the tool bar.

File menu

- **New.** Creates a new, empty image. You must indicate the size of the image. (When the image is part of a sprite with multiple images you cannot set the size.) (Remember, all images in a sprite must have the same size.)
- **Open.** Open an image from a file. This menu item is not available when the image is part of a sprite with multiple images.
- **Previous Image.** Only available when the image is part of a sprite with multiple images. Saves the changes and opens the previous subimage.
- **Next Image.** Only available when the image is part of a sprite with multiple images. Saves the changes and opens the next subimage.
- **Save as PNG File.** Saves the image as a PNG file. No other file formats are supported.
- **Close Saving Changes.** Closes the form, saving the changes made to the image. If you don't want to save the changes, click on the close button of the form.

Edit menu

Here you find the usual commands to Undo the last change and Redo the last undo, to delete, cut, or copy the current selection to the clipboard, to paste the image on the clipboard as a selection in the image, and to select all. (Note that when using the clipboard, transparency information might be lost.) Two additional commands require a bit more explanation.

- **Erase to Left Color.** This erases the image and replaces it by the left color (and opacity setting).

- **Paste from File.** You can select an image from a file. This image is then pasted into the current image as a selection. You can then move that selection to the appropriate place.

View menu

- **Zoom Out.** You can zoom out to see more of the image. You can also hold the <Ctrl> key and move the mouse scroll wheel to zoom in or out.
- **No Zoom.** Sets the image back to the normal size.
- **Zoom In.** You can zoom in to more precisely draw in an area of the image.
- **Toggle Grid.** You can toggle the grid on or off. Note that the grid is only shown when you zoom in enough.
- **Grid Options.** Here you can set the size of the grid and the color. You can indicate whether to use exclusive or when drawing the grid (might make it more visible) and whether the drawing should be snapped to the grid.
- **Show Preview.** Show a preview of the image in the right bottom corner in the normal size. This is in particular useful when you are zooming in a lot to make small changes. If the image is larger than the preview are you can use the mouse to drag the part of the image you want to see. You can also double click on the preview image to open a separate preview window in which you can see the complete image.
- **Set Tranparency Background.** Here you can indicate how the transparent area of the image should be shown in the sprite editor. You can either use the (default) block pattern, or a color that you can change by clicking on the color box.

Transform menu

This menu contains the same transformation commands as in the sprite editor. You can read about their function there. Note that **Resize Canvas**, **Stretch**, and **Crop** are not available when the image is part of a sprite with multiple images, because in that case we cannot change the size of the image.

Image menu

This menu contains the same commands as in the sprite editor. You can read about their function there. Note that some commands are only available in the Standard Edition.

More about sounds and music

In advanced mode you have a lot more control over the sounds and pieces of music you add to your game. When you add a sound resource the following form will show:

□

Besides the buttons to load, save, and play sounds there are a lot of settings now that will be discussed here.

First of all you can indicate the kind of sound. Four kinds are possible. Normal sounds are in general used for sound effects in wave files (although they can be used for midi files as well). Multiple normal sounds can play at the same time. You can even play multiple copies of the same sound simultaneously. Background music is similar to normal sounds but only one can play at any moment. So once you start a new background sound, the currently playing one will be stopped. Midi files are default background music. 3D sound is sound for which you can apply 3D settings through special functions. You will only need these for advanced sound effects.

Sound files are normally played through DirectX. This gives many possibilities but is limited to wave and midi files. If you want to play other files, like mp3 files, you should select the option to use the media player. This is much more limited though. No volume changes or effects can be used and only one piece can play at once. Note that midi files, when played through the media player may sound different from playing them as background or normal sounds. The reason is that the media player uses the hardware synthesizer (which is different on each machine) while otherwise a software version is used (which sounds the same on all machines). Preferably don't use mp3 files in you games. They need to be decompressed which takes processing time and might slow down the game. The fact that the file size is smaller does not mean that they use less memory. Also, not all machines support them. So your game might not run on all machines.

Secondly, you can indicate some sound effects, like chorus or echo (only in the Standard Edition of *GameMaker!*) You can select any combination. You can immediately listen to the results. (When using GML code you can even change the parameters of these effects.)

Also you can indicate the default volume of the sound and whether to pan it to the left or the right speaker.

For all sounds you can indicate whether they should be preloaded or not. When a sound is played it must be loaded into audio memory. If you preload the sound this is done at the start of the game, making it immediately available for playback. When not, it is loaded the first time it is used. This will save memory but might give a small delay the first time the sound is used.

GameMaker does not have a built-in sound editor. But in the preferences you can indicate external editors that you want to use for editing sounds. If you selected these you can press the button labeled **Edit Sound** to edit the current sound. (The *GameMaker* window will be hidden while you edit the sound and returns when you close the sound editor.)

More about backgrounds

In advanced more there are a number of additional options for background. First of all, a new button **Save Background** has appeared. With this button you can save the background in a proprietary format. This will not only store the image itself but also for example information about the tiles (see below). These files will have the extension `.gmbck`. You can load them in *GameMaker* and while running a game. Also you can also change a background or create your own backgrounds by pressing the button labeled **Edit Background**. A built-in image editor opens that has many features. Please realize that this is not a full-blown program and if you require more advanced editing tools you might want to use a separate drawing program. For more information on how to use the image editor see the section on [Editing images](#).

Sometimes you want to use a background as a set of tiles, that is, a collection of smaller images in one big image. When create the rooms you can then add these subimages at different places in the room. This is very useful for creating nice looking levels. To use a background as a tile set, check the box labelled **Use as tile set**. The form now changes to look as follows:

□

You can indicate a number of settings for the tile set. In particular you can indicate the width and height of each tile. (Only one size can be given, so better make sure that all tiles in the set have the same size. If you have different sizes, create two or more tile sets.) You can also indicate an offset where the top leftmost tile starts. Finally, a separation between the tiles (this is normally 0 or 1) can be indicated. For more information on using tiles, see the section on [Aggiungere Tiles](#) when creating rooms.

A word of warning is required here. When you put separating borders between the sprites and use interpolation between pixels (see the global game settings) this can result in cracks between the tiles. Better make sure the pixels around the tiles actually match with the pixels just inside the tiles to avoid this. You can easily achieve this by editing the background and changing the color of such pixels.

Di piÃ¹ sugli Objects

When you create an object in advanced mode, you can change some more advanced settings.

Depth

First of all, you can set the **Depth** of the instances of the object. When the instances are drawn on the screen they are drawn in order of depth. Instances with the largest depth are drawn first. Instances with the smallest depth are drawn last. When instances have the same depth, they are drawn in the order in which they were created. If you want to guarantee that an object lies in front of the others give it a negative depth. If you want to make sure it lies below other instances, give it a large positive depth. You can also change the depth of an instance during the game using the variable called depth.

Persistent objects

Secondly, you can make an object persistent. A persistent object will continue existing when you move from one room to the next. It only disappears when you explicitly destroy it. So you only need to put an instance of the object in the first room and then it will remain available in all rooms. This is great when you have a main character that moves from room to room. Using persistent objects is a powerful mechanism but also one that easily leads to errors.

Parents

Every object can have a parent object. When an object has a parent, it inherits the behavior of the parent. Stated differently, the object is a sort of special case of the parent object. For example, if you have 4 different balls, named ball1, ball2, ball3 and ball4, which all behave the same but have a different sprite, you can make ball1 the parent of the other three. Now you only need to specify events for ball1. The others will inherit the events and behave exactly the same way. Also, when you apply actions to instances of the parent object they will also be applied to the children. So, for example, if you destroy all ball1 instances the ball2, ball3, and ball4 instances will also be destroyed. This saves a lot of work.

Often, objects should behave almost identically but there will be some small differences. For example, one monster might move up and down and the other left and right. For the rest they have exactly the same behavior. In this case almost all events should have the same actions but one or two might be different. Again we can make one object the parent of the other. But in this case we also define certain events for the child object. These events "override" the parent events. So whenever an event for the child object contains actions, these are executed instead of the event of the parent. If you also want to execute the parent event you can call the so-called "inherited" event using the appropriate action.

It is actually good practice in such cases to create one base object. This base object contains all the default behavior but is never used in the game. All actual objects have this base object as parent. Parent objects can again have parents, and so on. (Obviously you are not allowed to create cycles.) In this way you can create an object hierarchy. This is extremely useful to keep your game structured and you are strongly advised to learn to use this mechanism.

There is also a second use of the parent object. It also inherits the collision behavior for other objects. Let us explain this with an example. Assume you have four different floor objects. When a ball hits the floor it must change direction. This has to be specified in the collision event of the ball with the floor. Because there are four different floors we need to put the code on four different collision events of the ball. But when you make one base floor object and make this one the parent of the four actual floor objects, you only need to specify the collision event with this base floor. The other collisions will perform the same event. Again, this saves a lot of copying.

As indicated, wherever you use an object, this also implies the descendants. This happens when, in an action, you indicate that the action must be applied to instances of a certain object. It also happens when you use the `with()` statement in code (see below). And it works when you call functions like `instance_position`, `instance_number`, etc. Finally, it works when you refer to variables in other objects. In the example above when you set `ball1.speed` to 10 this also applies to ball2, ball3 and ball4.

Masks

When two instances collide a collision event occurs. To decide whether two instances intersect, the sprites are used. This is fine in most cases, but sometimes you want to base collisions on a different shape. For example, if you make an isometric game, objects typically have a height (to give them a 3D view). But for collisions you only want to use the ground part of the sprite. This can be achieved by creating a separate sprite that is used as collision mask for the object.

Information

The button **Show Information** gives an overview of all information for the object that can also be printed. This is particularly useful when you loose overview of all your actions and events.

More actions

In advanced mode there are a number of additional actions available which will be described here.

Information on the different additional actions can be found in the following pages:

[More Move Actions](#)

[More Main Actions](#)

[More Control Actions](#)

[Altre Azioni di Disegno](#)

[Particle Actions](#)

[Extra Actions](#)

More Move Actions

Some additional move actions are available in advanced mode. The following actions are added:

▣ **Set Path**

With this action you can specify that the instance should follow a particular path. You indicate the path that must be followed and the speed in pixels per step. When the speed is positive the instance starts at the beginning of the path. If it is negative it starts at the end. Next you specify the end behavior, that is, what should happen when the end of the path is reached. You can choose to stop the motion, restart from the beginning, restart from the current position (which is the same when the path is closed), or reverse the motion. Finally you can indicate that the path must be seen as absolute, that is, the position will be as indicated in the path (this is useful when you have designed the path at a particular place in the room) or relative, in which case the start point of the path is placed at the current location of the instance (end point when speed is negative). See the chapter on paths for more information.

▣ **End Path**

Use this action to stop the path for the instance.

▣ **Path Position**

With this action you can change the current position of the instance in the path. This must be a value between 0 and 1 (0=beginning, 1=end).

▣ **Path Speed**

With this action you can change the speed of the instance on the path. A negative speed moves the instance backwards along the path. Set it to 0 to temporarily stop the motion along the path.

▣ **Step Towards**

This action should be placed in the step event to let the instance take a step towards a particular position. When the instance is already at the position it will not move any further. You specify the position to move to, the speed with which to move, that is, the size of the step, and whether the motion should stop when hitting a solid instance or when hitting any instance.

▣ **Step Avoiding**

This is a very powerful motion action. It should be placed in the step event. Like the previous action it lets the instance take a step towards a particular position. But in this case it tries to avoid obstacles. When the instance would run into a solid instance (or any instance) it will change the direction of motion to try to avoid the instance and move around it. The approach is not guaranteed to work but in most easy cases it will effectively move the instance towards the goal. For more complicated cases, there are motion planning functions. You specify the position to move to, the speed with which to move, that is, the size of the step, and whether the motion should avoid solid instances or any instance.

More main actions

Some additional main actions are available in advanced mode. The following actions are added:

□ Set Time Line

With this action you set the particular time line for an instance of an object. You indicate the time line and the starting position within the time line (0 is the beginning). Also you indicate whether the time line should start immediately and whether it should loop at the end.

□ Time Line Position

With this action you can change the position in the current time line (either absolute or relative). This can be used to skip certain parts of the time line or to repeat certain parts.

□ Time Line Speed

With this action you can change the speed of the time line (either absolute or relative). A speed of 1 is the normal speed. When you e.g. set it to 2 the actions will happen twice as fast and when you set it to 0.5 twice as slow. You can also set a negative speed, in which case the time line is played backwards.

□ Start Time Line

This action starts the time line from its current position (if it is paused or stopped).

□ Pause Time Line

This action pauses the time line. Use the start action to let it continue.

□ Stop Time Line

This action stops the time line and sets the position back to 0.

□ Splash Text

With this action you can show a text file. This can either be a .txt file or a .rtf (Rich Text Format) file (no images or embedded objects are shown though). You specify the file name. Make sure the file exists. You should either distribute it with the game or include it in the game through **Include Files** in the **Resources** menu. (Note that no scrollbar will be shown nor is there another way to scroll the text. So the text must fit the window.) ***This action is only available in the Standard Edition.***

□ Splash Image

With this action you can show an image file. Most common image file types are supported. You specify the file name. Make sure the file exists. You should either distribute it with the game or include it in the game through **Include Files** in the **Resources** menu. You can e.g. use this to create a series of images as help for your game. Not including the images in the game itself will reduce game size and improve game loading time. ***This action is only available in the Standard Edition.***

□ Splash Webpage

With this action you can show a webpage. You provide the url and whether it should be shown in the game window or in the default web browser. The url can be the address of a website, for example <http://www.yoyogames.com>) or can be the file name for a local html file. Note however that you must provide the full path for this to work (which is not the case for the other splash actions). So you best use as url something like "" + working_directory + "\\index.html". (The first two quotes are required to indicate this is an expression rather than a string.) You should either distribute the file with the game or include it in the game through **Include Files** in the **Resources** menu. You can e.g. use this to create fancy help pages for your game. ***This action is only available in the Standard Edition.***

□ Splash Video

With this action you can show a video/movie file. You specify the file name and whether it must be looped. Make sure the video file exists. You should either distribute it with the game or include it in the game through **Include Files** in the **Resources** menu. ***This action is only available in the Standard Edition.***

□ Splash Settings

With this action you can change certain settings for the splash screens that you display with the previous actions. You can provide the caption for the help window (only when it is shown in a separate normal window), you can indicate where the splash screens must be shown (inside the game window, in a normal window, or full screen), you can indicate whether a close button must be shown in the top right corner of the splash screen and whether pressing the escape key or clicking with a mouse in the splash screen will close the splash screen. (For web pages clicking with the mouse will not work nor will the

escape key work unless the close button is shown.) ***This action is only available in the Standard Edition.***

▣ **Replace Sprite**

This action can be used to replace a sprite from the contents of a file. You indicate the sprite you want to replace, the filename and the number of subimages in the sprite. Many different images file formats are supported, e.g. .bmp, .jpg, .tif, and .gif. For a gif file the number of subimages is automatically decided based on the number of subimages in the gif file. Other settings for the sprite, e.g. whether it is transparent or not, are not changed. You can use this action to avoid storing all sprites in the program itself. For example, at the beginning of a level you can replace sprites by the actual character sprites you want to use. DON'T change a sprite that is at that moment being used in an instance in the room. This might give unwanted effects with collisions. ***This action is only available in the Standard Edition.***

▣ **Replace Sound**

With this action you can replace a sound by the contents of a file (.wav, .mid, or .mp3). You specify the sound and the filename. This avoids having to store all the sounds in the game itself. For example, you can use different pieces of background music and pick the one you want to play. DON'T change a sound while it is playing. ***This action is only available in the Standard Edition.***

▣ **Replace Background**

With this action you can replace a background by the contents of a file. Many different images file formats are supported, e.g. .bmp, .jpg, .tif, and .gif. You specify the background and the filename. This avoids having to store all the backgrounds in the game itself. DON'T change a background that is visible. ***This action is only available in the Standard Edition.***

More control actions

Some additional control actions are available in advanced mode. The following actions are added:

- ▣ **Execute Script**

With this action you can execute a script that you added to the game. You specify the script and the maximal 5 arguments for the script.

- ▣ **Call Parent Event**

This action is only useful when the object has a parent object. It calls the corresponding event in the parent object.

Altre Azioni di Disegno

Le seguenti funzioni di disegno aggiuntive sono disponibili nella modalità avanzata:

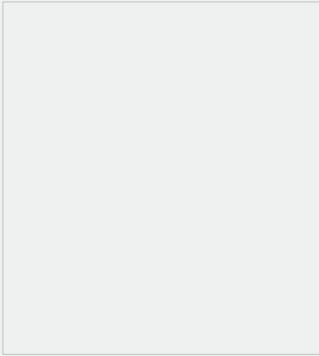
☐ **Imposta Font**

Puoi impostare il tipo di carattere che verrà usato da questo momento in poi per il disegno del testo. Questo dev'essere uno dei font delle risorse che hai definito. Se non scegli nessun font un predefinito verrà usato il font Arial a 12 punti.

Particle Actions

A set of actions dealing with particles is available on the **Extra** tab. *These actions are only available in the Standard Edition of GameMaker.*

Particle systems are meant to create special effects. Particles are small elements (represented by a pixel or a little shape). Such particles move around according to predefined rules and can change color while they move. Many such particles together can create e.g. fireworks, flames, rain, snow, star fields, flying debris, etc.



GameMaker contains an extensive particle system that can be accessed through functions. A more limited particle system can be accessed through the actions described below.

A particle system can deal with particles of different types. After creating the particle system the first thing to do is specify the particle types. Using the actions below you can specify up to 16 types of particles. Each type has a shape, a size, a start color and an end color. The color slowly changes from the start color to the end color. Particles have a limited life time. In the type you specify the minimal and maximal life time of the particles. Particles also have a speed and a direction. Finally, gravity and friction can work on particles.

After you specify the particle types you must create them at places in the room. You can either burst a number of particles of a particular type from a place or you can create a constant stream of particles appearing. Particles appear at emitters. The particle system can have up to 8 emitters working at the same time. So after you create the particle types you must create the emitters and tell them to burst or stream particles.

Here is the complete set of actions. Best experiment with them to get the required effect.

□ Create Part System

This action creates the particle system. It must be called before any other actions can be used. You only need to call it once. You can specify the depth at which the particles are drawn. If you use a large positive depth the particles appear behind the instances. If you use a negative depth they appear in front of the instances.

□ Destroy Part System

This action destroys the particle system, freeing all its memory. Don't forget to call this (e.g. when you move to a different room) because particle systems use a lot of storage.

□ Clear Part System

This action removes all the particles currently visible. It does not stop the emitters so new particles might be created again if you have streaming emitters (see below).

□ Create Particle

With this action you create a particle type. You can choose one of the 16 types available. For the particle type you can specify its shape or the sprite to be used for it. If you specify a sprite the sprite will be used. If you set the sprite to no sprite, the shape will be used. There are a number of interesting built-in shapes. You also indicated its minimal and maximal size (when the particle appears a random value between these bounds is used). Finally you specify the increase in size in each step. For a decrease, use a negative value. Note that only a particle type is created, not an actual particle. For this you need emitters (see below).

□ Particle Color

A particle can have a color (default the color is white). With this action you can set the color to be used for a particular type. You

must indicate the particle type the color is defined for. Next you specify how a color is applied. Either a random color is chosen between two given colors, or the color starts with the first color and then gradually over the lifetime of the particle, it changes to the second color. Both colors must be given. Finally you can indicate the alpha transparency. You specify the transparency at the moment the particle is created and when it dies. The transparency slowly changes between these values. It is normally nice to decrease the alpha value over the lifetime of a particle.

□ **Particle Life**

A particle lives for a limited number of steps. After this it disappears. With this action you set the life time for a particle type. You give two limiting values and the actual life time is chosen randomly between them.

□ **Particle Speed**

With this action you can set the speed and direction of motion for a particle type. Again you give two limits and the actual value is chosen randomly between them. For example, to make the particle move in a random direction, give 0 and 360 for the limits for the direction. You can also specify a friction. This amount is subtracted from the speed in each step until it becomes 0. (You can make a particle speed up by using a negative friction.)

□ **Particle Gravity**

With this action you set the amount of gravity and direction of gravity for a particular particle type. 270 is downwards.

□ **Particle Secondary**

This is a bit more complicated. Particles can create other particles during their life time and when they die. With this action you can specify this. You can define the type and number of particles that must be created at each step during the life time and you can specify the type and number of particles that must be created when the particle dies. Be very careful here. You can easily create huge numbers of particles in this way, slowing down the system considerably. For the numbers you can also use a negative value. A negative value x means that in each step a particle is created with chance $-1/x$. So for example, if you want to generate a secondary particle about every 4 steps, use a value of -4. Secondary particles are great for creating effects like tails of particles or exploding particles.

□ **Create Emitter**

This action creates a particle emitter. Particles are generated by emitters. You can have up to eight emitters. Choose the emitter and specify the shape of it and its size and position (in the form of a bounding box).

□ **Destroy Emitter**

This action destroys the indicated emitter. Note that existing particles that came from this emitter are not removed.

□ **Burst from Emitter**

Even if you defined a particle type and an emitter there are still no particles. You still have to tell the emitter to generate the particles. With this action you tell a particular emitter to generate a given number of particles of a given type. All these particles are generated at once. For the number you can also use a negative value. A negative value x means that a particle is created with chance $-1/x$. So for example, if you want to generate a particle with a chance of 25 percent, use a value of -4.

□ **Stream from Emitter**

With this action you tell a particular emitter to stream a given number of particles of a given type. In each step this number of particles is generated, leading to a continuous stream of particles. The emitter will continue streaming particles until you destroy it or tell it to stream 0 particles. For the number you can also use a negative value. A negative value x means that in each step a particle is created with chance $-1/x$. So for example, if you want to generate a particle about every 4 steps, use a value of -4.

Extra Actions

On the **Extra** tab there also are a number of actions related to the playing of CDs. *These actions are only available in the Standard Edition of GameMaker.*

□ Play CD

With this action you can play some tracks from a CD in the default CD-drive. You specify the starting track and the final track.

□ Stop CD

Stops the currently playing CD.

□ Pause CD

Pauses the currently playing CD.

□ Resume CD

Resumes a paused CD.

□ Check CD

If there is a CD in the default drive then the next action is executed.

□ Check CD Playing

If a CD is playing in the default drive then the next action is executed.

Finally, there are an additional action that can be useful in certain games.

□ Set Cursor

You can use this action to replace the windows mouse cursor by a sprite. You specify the sprite and whether the windows mouse cursor should still be shown. The sprite can be animated. Note that the sprite will only be shown in the room, not in the area outside it.

Constants

This functionality is only available in the Standard Edition of GameMaker.

In advanced mode you can define constants that you can use in scripts and in values for actions. Each constant has a name and a value. Names should follow the same rules as variables, that is, they must start with a letter or underscore symbol and further consist of letters, digits or underscore symbols. You are though strongly recommended to make all your constants easily distinguishable. A usual convention is to use only capital letters and underscores.

To define constants you chose **Define Constants** from the **Resources** menu. The following form will show (in which already some constants have been defined):

□

At the top you see the constants. At the left there is the name and at the right the value. You can select the name or value with the mouse and change it by typing. A value of a constant should be a constant expression. That is, it is either a constant number or a string (with quotes around it) or it is an expression. The expression is evaluated before anything else happens in the game. So it for example cannot reference the current room, instances, or scripts. But it can contain the built-in constants and the names of resources.

You can append a constant at the end of the list using the button **Add** (or by pressing Enter) and delete it using **Delete**. You can also insert a constant above the current selected constant. There are also buttons to clear all constants, to move them up or down in the list, and to sort them by name.

Finally you can save all constants to a text file or load them from a text file. This is useful when you want to store collections of useful constants for later use. When loading constants they are appended to the current list. The text file can also be edited using a text editor. Each line contains a constant definition of the form NAME=VALUE.

It is good practise to put any value that you use multiple times in a constant. Also, if you are not completely sure about a certain value you better put it in a constant as it is a lot easier to change the constants than to find the values in the scripts and actions and change them there.

Eventi Trigger

This functionality is only available in the Standard Edition of GameMaker.

In advanced mode a new type of events is available: trigger events. Eventi Trigger you can define yourself. You specify the condition when the event must be executed. To define trigger events you chose **Define Triggers** from the **Resources** menu. The following form will show (in which already some triggers have been defined):

□

At the left you see a list of all triggers that have been defined. Initially this list is empty. Below there are some buttons with the following function:

- **Add.** Use this button to add a new trigger event to the list.
- **Delete.** Deletes the currently selected trigger event to the list. Be careful to never delete a trigger event that is used in an object. It might lead to unexpected results.
- **Load.** Loads a collection of triggers from a file. Such a file must have extension .gmtrg. The triggers from the file are added to the list of triggers.
- **Save.** Saves the collection of triggers to a file. Such a file must have extension .gmtrg. In this way you can create your own collections of useful triggers that you can use in different games.
- **Clear.** Clears the list of triggers. Be careful to only use this when no object uses any trigger event.

Once you are finished you can press the **OK** button to save the changes. If you do not want to save the changes, close the form with the cross in the top right corner and indicate that you do not want to save changes.

Defining a trigger

Once you added a trigger you should fill in its properties. First of all you must give the trigger a name. This name will appear in the menu with available triggers and in the event lists for objects. Next you must specify the condition that will trigger the event. This is a piece of GML-code. It must contain a return statement that returns a true or false value. The trigger will fire when the return value is true. Here are some examples.

Assume you want to create an event that happens when the player presses both the Control key and the Akey. For this you can use the following condition:

```
{
    return keyboard_check(ord('A')) &&
        keyboard_check(vk_control);
}
```

You can put complete scripts in the condition as long as there somewhere is a return statement. For example, to have an event that happen when the number of balls is between 3 and 5, you can use the following condition:

```
{
    var n;
    n = instance_number(obj_ball);
    return (n >= 3) && (n <= 5);
}
```

You can create many other type of trigger events. For example events that check for combinations of keys and mouse buttons, events that check whether you are near to an enemy, events to check whether you collected enough money or score, etc.

If the condition gets a bit long you might want to edit it in the code editor instead. To that end press the button **Use code editor**.

After you specified the condition you should specify when the condition is tested. There are three options here. You can test the condition at the beginning of a step (just before the begin step event), in the middle (just before the normal step event) or at the end (just before the end step event). Most of the time the default middle position is fine but in certain cases you need

the other moments.

Finally, when you also want to call the event from code you can specify a constant with which you can refer in code to the event. See Chapter 4 for more details about calling events from code.

Using a trigger

Once you have defined your scripts you can use them when defining objects. When setting the object properties and click on **Add Event**, you can now select **Trigger** events.

□

In the drop-down menu that appears you can select the type of trigger event you want to use. Now you can add actions to this event in the same way as you add actions to other events.

Including files in stand-alone games

This functionality is only available in the Standard Edition of GameMaker.

As has been indicated before, you can create stand-alone versions of your game. Sometimes your game will use additional files. For example you might want to include video files or text files that are used in the game. In some cases you want to add DLLs or images and sounds that are loaded during the running of the game. You can provide these together with the stand-alone executable but it is sometimes easier to include them in the file. In this way only one file needs to be distributed. Included files will default be exported when the game starts.

You can indicate the files you want to include in the executable in by choosing **Included Files** from the **Resources** menu. The following form will be shown:

□

At the top of the form is a list of files to include. Use **Add** to add a new file to the list, **Change** to change a selected file, **Delete** to delete the selected file, and **Clear** to clear the complete list. When adding or changing an entry, the following form will pop up:

□

Here you can indicate a number of properties. You can press the **Load** button to indicate which file must be included. You can change the **File Name** if you want to save the file under a different name than the original file name.

There are a number of options you can set. When you check **Store in the editable .gm81 file** the included file is not only added to the executable but also to the editable version of the game. The advantage is that you can e.g. send the editable version to somebody else and can be sure the file is still there. Also, you can remove the included file if you want or move it elsewhere without problems. The disadvantage is that the editable version of the game becomes larger and takes longer to load.

Checking the option **Free memory after export** means that after the file has been exported (when running the game) it will be removed from memory. If you want to be able to export it again later you should uncheck this option. If a file that is exported already exists it is normally not written. You can change this behavior by checking **Overwrite existing files**. Also, when the game is finished the files are normally not removed (unless they are in the temporary folder which is completely removed). You can change this by checking **Remove at game end**.

A word of warning is in place here. If you are testing your game, the working directory of the game is the directory where the .gm81 file is stored. If your include files are also stored here and you choose to remove them at the end of the game you might loose them altogether! So better not store these files with the .gm81 file but e.g. in a subfolder!

Finally you can indicate to what folder the files are exported. There are four options here. In the default situation the files are exported in the folder where the stand-alone game is stored. This is also the working directory for the game. So the game can just use the file names to access them (no paths are required). This works well if the stand-alone is stored e.g. on the hard disk but will fail if it is stored on a read-only device, e.g. on a CD.

The second possibility is to indicate that the files must be exported into the temporary folder that is created during the running of the game. If you select this option you will need to provide the path to the temporary folder when you use the file name during the game. This path can be obtained using the built-in variable `temp_directory`. Don't forget to add the backslash in this case. So to e.g. play a video file you might type in the following piece of code:

```
{
    splash_show_video(temp_directory+'\\movie.avi', true);
}
```

Realize that this temporary folder is removed once the game is finished. So you e.g. cannot store save games or special information in this case. Only choose this option when you want the game to be run from a CD or when you do not write any files from within your game.

The third option is to indicate the folder to which the file must be exported yourself. If it does not exist it will be created. E.g. you could specify `C:\MyGame`. (Note that you need to provide a full path and that you should not include a backslash at the end.) This is only allowed when the game does not run in secure mode.

Finally, you can indicate not to export the file automatically. In this case you should use e.g. the function `export_include_file(fname)` to export it yourself when required.

Di piÃ¹ sulle Rooms

Rooms in *GameMaker* have many options. Before we only treated the most important ones. In this chapter we will discuss the other options. When you open the room form in advanced mode it looks as follows:

□

As you will see, some new buttons have been added to the toolbar. There are buttons to sort the instances horizontally or vertically. This is useful when instance partially overlap. (When adding tiles these buttons and the others work on the tiles rather than the instances.) Also there are buttons to lock all instances or unlock all instances. Locked instances cannot be moved or deleted. This protects you against incidentally removing instances. (However, when using the toolbar buttons to delete or shift all instances, also the locked ones are deleted or shifted.) Using the right mouse button menu (hold <Ctrl> and right click on an instance) you can also lock or unlock individual instances.

Finally, you can indicate that you want to use an isometric grid. This is very useful when creating isometric games. First of all, the grid lines now run diagonally. Also the snapping of instances is different. (It works best when the origin of the instance is at the top left corner as is default.)

Also there are two new tabs which we will discuss below.

Information on the different advanced room options can be found in the following pages:

[Advanced settings](#)

[Aggiungere Tiles](#)

[Views](#)

Advanced settings

There were two aspects in the **settings** tab that we have not yet discussed. First of all, there is a checkbox labeled **Persistent**. Normally, when you leave a room and return to the same room later, the room is reset to its initial settings. This is fine if you have a number of levels in your game but it is normally not what you want in for example an RPG. Here the room should be the way you left it the last time. Checking the box labeled **Persistent** will do exactly that. The room status will be remembered and when you return to it later, it will be exactly the same as you left it. Only when you restart the game will the room be reset. Actually, there is one exception to this. If you marked certain objects as being persistent, instances of this object will not stay in the room but move to the next room.

Secondly, there is a button labeled **Creation code**. Here you can type in a piece of code in GML (see later) that is executed when the room is created. This is useful to fill in certain variables for the room, create certain instances, etc. It is important to understand what exactly happens when you move to a particular room in the game.

- First, in the current room (if any) all instances get a room-end event. Next the non-persistent instances are removed (no destroy event is generated!).
- Next, for the new room the persistent instances from the previous room are added.
- All new instances are created and their creation events are executed (if the room is not persistent or has not been visited before).
- When this is the first room, for all instances the game-start event is generated.
- Now the room creation code is executed.
- Finally, all instances get a room-start event.

So, for example, the room-start events can use variables set by the creation code for the room and in the creation code you can refer to the instances (both new ones and persistent ones) in the room.

There is one further option. In the pop-up menu when you right click on an instance with the <Ctrl> key you can now indicate some creation code for the specific instance. This code is executed when the room is started, just before the creation event of the instance is executed. This is very useful to e.g. set certain parameters that are specific to the instance.

Aggiungere Tiles

You can also create so-called tiled background. The idea behind this is as follows: In many games you will want to have nice looking backgrounds. For example, in a maze game, the walls of the maze should nicely match up, and in platform games you like to see beautifully drawn platforms, trees, etc. You can do this in *GameMaker* by defining many different objects and composing your rooms from these objects. The problem though is that this takes a lot of work, uses large amounts of resources, and makes the games run slowly because of the many different objects. For example, to create nice walls in maze games you need as a start 15 differently shaped wall objects.

The standard way out, used in many games, is that the walls and other static objects are actually drawn on the background. But, you might ask, how does the game know that an object hits a wall if it is drawn on the background only? The trick is as follows: You create just one wall object in your game. It must have the right size but it does not need to look nice. When creating the room, place this object at all places where there is a wall. And, here comes the trick, we make this object invisible. So when playing the game you don't see the wall objects. You see the beautiful background instead. But the solid wall objects are still there and the instances in the game will react to them.

You can use this technique for any object that is not changing its shape or position. (You cannot use it when the object must be animated.) For platform games, you probably need just one floor and one wall object, but you can make beautifully looking backgrounds where it looks as if you walk on grass, on tree branches, etc.

To add tiles to your room you first need to add a background resource to your game that contains the tiles. If you want to have your tiles partially transparent, make sure you make the background image transparent when loading it. When adding the background resource indicate that it must be used as a tile set. Next indicate the size of each tile and whether there is room between the tiles, as was indicated in the chapter on background resources.

Now, when defining your room, click on the tab **tiles**. The following form is shown (actually, we already added some tiles in this room and switched off the grid).

□

At the left top there is the current set of tiles used. To select the set, click on the menu button below it and select the appropriate background image.

Now you can add tiles by selecting the tile you want at the top left, and next clicking at the appropriate place in the room at the right. This works in exactly the same way as for adding instances. Underlying tiles are removed, unless you uncheck the box **Delete underlying**. You can use the right button to delete tiles. Hold the <Shift> key to add multiple tiles. And hold the <Ctrl> key to move tiles to a new place. The <Alt> key will avoid snapping to the grid. Also there is again a pop-up menu when you hold the <Ctrl> key and click on a tile with the right mouse button. The buttons in the toolbar will now clear all tiles, shift all tiles, sort the tiles or lock/unlock them. (Actually they only operate on the current layer; see below.)

In some situations you might want to put a part of the background in the room that is not exactly the size of a tile or consists of multiple tiles. This can be done as follows. In the top-left image press the left mouse button while holding the <Alt> key. Now you can drag an area which you can then place in the room in the same way as tiles. To select multiple tiles, hold the <Shift> key. Note that this only works correctly when there is no separation between the tiles. If you want to select an area that is multiple of the room grid size, hold the <Ctrl> key rather than the <Shift> key. (Note that you can actually change the key you hold during the dragging. This can sometimes be useful.)

Tiles can be placed in layers at different depths. At the bottom you see the current depth. Default this is 1000000 which is normally behind all instances. So the instances will move in front of the tiles. You can use the **Add** button to add new tile layers, each with a different depth. Negative depths can be used to put tiles in front of instances. If you also give objects different depths you can put them between different tile layers. If you press **Delete** you delete a tile layer together with all its tiles. (There must always be at least one layer.) If you press **Change** you can change the depth of a tile layer. If you give it the same depth as another layer, the layers are merged.

Using tiles is a powerful feature that should be used as much as possible. It is much faster than using objects and the tile images are stored only once. So you can use large tiled rooms with very little memory consumption.

Views

Finally, there is a tab labeled **views**. This gives a mechanism for drawing different parts of your room at different places on the screen. There are many uses for views. First of all, in a number of games you want to show only part of the room at any time. For example, in most platform games, the view follows the main character. In two-player games you often want a split-screen mode in which in one part of the screen you see one player and in another part you see the other player. A third use is in games in which part of the room should scroll (e.g. with the main character) while another part is fixed (for example some status panel). This can all be easily achieved in *GameMaker*.

When you click the tab labeled **views** the following information will show:

□

At the top there is a box labeled **Enable the use of Views**. You must check this box to use views. Below this you see the list of at most eight views you can define. Below the list you can give information for the views. First of all you must indicate whether the view should be visible when the room starts. Make sure at least one view is visible. Visible views are shown in bold.

A view is defined by a rectangular area in the room. This is the area that must be shown in the view. You specify the position of the top-left corner and the width and height of this area. Secondly, you must specify where this area is shown in the window on the screen. This is called the (view)port. Again you specify the position of the top-left corner and the size. If you have a single view the position is typically (0,0). Note that the size of the port can be different from the size of the view. In this case the view will be scaled to fit in the port. (In code it is also possible to rotate a view.) The ports can overlap. In this case they are drawn in the indicated order on top of each other.

As indicated above, you often want the view to follow a certain object. This object you can indicate at the bottom. If there are multiple instances of this object, only the first one is followed by the view. (In code you can also indicate that a particular instance must be followed.) Normally the character should be able to walk around a bit without the view changing. Only when the character gets close to the boundary of the view, should the view change. You can specify the size of the border that must remain visible around the object. Finally, you can restrict the speed with which the view changes. This might mean that the character can walk off the screen, but it gives a much smoother game play. Use -1 if you want the view to change instantaneously.

Fonts

When you want to draw text in your game this text is drawn in an Arial 12 points font. To make more fancy looking texts you probably want to use different fonts. To use different fonts you must create font resources. In each font resource you specify a particular type of font which can then be used in your game using the action to set a font.

To create a font resource in your game, use the item **Create Font** in the **Resources** menu or use the corresponding button on the toolbar. The following form will pop up.

□

As always you should give your font resource a name. Next you can pick the name of the font. Also you can indicate its size and whether it should be bold and/or italic. Realize that large fonts take a lot of memory to store. So you are strongly recommended not to use fonts with a size larger than say 32. (It is possible to scale the fonts while running the game.) An example of the indicated font is shown at the bottom.

A font typically consist of 256 characters, numbered from 0 to 255. But in general you use only a small portion of these. So default in a font only the characters from 32 till 127 are stored in the font. The more characters you store in the font the more memory it will use. You can change the character range used. To see the index of each character you can use the Character Map that can be found in the Windows Start menu under Accessories/System Tools. Some standard ranges can be indicated using the buttons: The **Normal** range from 32 till 127, the **All** range from 0 till 255, the **Digits** range that only contains the 10 digits, and the **Letters** range that contains all uppercase and lowercase letters. Other ranges can be used by typing in the first and last character index. If a character does not lie in the range it is replaced by a space.

Normally you have a large number of different fonts installed on your computer and there are websites where you can download hundreds more. The problem is that if you use them in your game and then give your game to somebody else to play there is a big chance that the other person does not have the same fonts installed on his or her computer. To avoid this, *GameMaker* embeds all the fonts you want to use in the game file, but only in the stand-alone games. So if you give a stand-alone game to someone else you don't need to provide the font files. But if you give somebody the editable version of your game and you use fancy fonts, you better also provide the person with the correct font files.

The **Anti-Aliasing** drop box allows you to specify the level of anti-aliasing applied to the font. There are 4 levels from 0 to 3. You will currently have to run the game in order to see the fully anti-aliased font.

You can also select the **Character Set** codepage the font uses, and this will allow basic multi-language support.

Please note that the render window does not currently show the current character or AAselection, it's simply a sample of the FONT.

Paths

In more advanced games you often want to let instances follow certain paths. Even though you can indicate this by e.g. using timer events or code, this is rather complicated. Path resources are an easier mechanism for this. The idea is rather simple. You define a path by drawing it. Next you can place an action in the creation event of the object to tell the object to follow the particular path. This chapter will explain this in detail.

Defining paths

To create a path in your game, choose **Create Path** from the **Resources** menu. The following form will pop up (in the example we already added a little path).

□

At the top left of the form you can set the name of the path, as usual. Below it you find the points that define the path. Each point has both a position and a speed (indicated with sp). Depending on how you use the path, the position is either absolute, that is, the instance for which you will later use the path will follow it at that particular place, or it is relative, that is, the instance will always start at the first position on the path and follow the path from there. The speed should be interpreted as follows. A value of 100 means the original speed given for the path when assigning it to the instance. A lower value reduces the speed, a higher value increases it (so it indicates the percentage of the actual speed). Speed will be interpolated between points, so the speed changes gradually.

To add a point press the button **Add**. A copy is made of the currently selected point. Now you can change the actual position and speed by changing the values in the edit boxes. Whenever you select a point in the list, you can also change its values. Press **Insert** to insert a new point before the current one, and **Delete** to delete the current point.

At the right of the form you will see the actual path. The red dot indicates the currently selected control point. The blue dots are the other control points. The green square indicates the position where the path starts. You can also change the path using the mouse. Click anywhere on the image to add a point. Click on an existing point and drag it to change its position. When you hold <Shift> while clicking on a point, you insert a point. Finally, you can use the right mouse button to remove points. (Note that you cannot change the speed this way.) Normally the points will be aligned with a grid. You can change the grid settings at the top tool bar. Here you can also indicate whether the grid should be visible or not. If you want to precisely position a point, hold the <Alt> key while adding or moving it.

You can influence the shape of the path in two ways. First of all you can use the type of connection. You can either choose straight line connections or a smooth path. Secondly, you can indicate whether the path must be closed or not.

On the toolbar there are a number of important controls. From left to right they have the following meaning. The first button indicates that you are ready and want to close the form, keeping the changes. (If you want to discard the changes, press the cross to close the window and indicate that you do not want to save the changes.) Next there is the button to undo the last change.

The following set of toolbar buttons allows you to clear the path, reverse the order in which the path is traversed, shift the path, mirror it horizontally, flip it vertically, rotate it, and scale it. Next there are buttons to shift the view (not the path itself; the actual view area is indicated in the status bar at the bottom) and to center the view. You can also use the middle mouse button to PAN around the view around

As already indicated above you can next set the snap values and whether to show the grid. Finally there is a button to indicate that you want to see a particular room as background for the path. Using this you can easily put the path at a particular place in the room, for example on a race track, so that later the instances will follow the correct route. (This only makes sense when you use absolute paths; see below.)

Assigning paths to objects

To assign a path to an instance of an object, you can place the path action in some event, for example in the creation event. In this action you must specify the path from the drop down menu. There are some further values you can provide.

You must indicate the path that must be followed and the speed in pixels per step. When the speed is positive the instance starts at the beginning of the path. If it is negative it starts at the end. Remember that when you defined the path you specify the actual speed relative to this indicated speed. There is also an action to change the speed with which the path is executed. You could, for example, use this to let an instance slow down or speed up along its path. Note that the normal speed of the instance is ignored (actually set to 0) when executing a path. Also things like gravity and friction do not influence the motion along a path.

Next you specify the end behavior, that is, what should happen when the end of the path is reached. You can choose to stop the motion and end the path. You can also restart the path from the beginning, that is, the instance jumps back to the position where the path was started and executes the path again. A third option is to restart from the current position, that is, the instance follows the path again but now with this new starting position (this is the same when the path is closed). Finally you can choose to reverse the motion, making the instance go back and forth along the path. Note that also at the end of the path an event happens; see below.

Finally you can indicate whether the path must be absolute or relative. An absolute path is executed at the place where it is defined. The instance is placed at the start position and moved from there (end position when speed is negative). This is, for example, useful when you have a race track on which you have defined the path. When you choose relative the instances starts executing the path from its current position. This is useful when an instance should make a local motion. For example, space ships in a space invader game can make a particular turn from their current position.

When you want to place the instance at a different point along its path you can use the action to set the path position. A path position always lies between 0 and 1, 0 indicating the start position and 1 the end position on the path. Note that in each step the direction variable is automatically set to the correct direction along the path. You can use this variable to choose the correct orientation for the sprite.

When using scripts or pieces of code you have more control over the way the path is executed. There is a function to start a path for an instance. The variable `path_position` indicates the current position on the path (between 0 and 1 as indicated above). The variable `path_speed` indicates the speed along the path. A variable `path_scale` can be used to scale the path. A value of 1 is the original size. A larger value indicates that the path is made larger; a smaller value makes it smaller. The variable `path_orientation` indicates the orientation in which the path is executed (in degrees counter-clockwise). This enables you to execute the path in a different orientation (e.g. moving up and down rather than left and right). There is also a variable to control the end behavior. Finally there are lots of functions to ask for properties of paths (e.g. the x and y coordinate at a certain positions) and there are functions to create paths. There are even functions that create collision free paths for an instance to reach a certain goal. See the later sections on GML for details on this.

You might wonder what happens when the instance collides with another instance while it follows a path. Basically the same happens as when the instance moves with a speed. When there is a solid instance, the instance is placed back at its previous location. When both instances are not solid they are placed at their new positions. Next the collision event(s) are executed and it is checked whether the collision has been resolved. If not and the other instance is solid the instance will stop, as it should (assuming there is a collision event defined). Also, the `path_position` variable is not increased. When the blocking instance disappears the instance will continue to follow its path. To handle collisions yourself the variable `path_positionprevious` can be useful. It holds the previous position for the path and you can set the path position to this variable to avoid advancing along the path.

The path event

As described above, you can indicate what must happen when the instance reaches the end of the path. At this moment also an **End of Path** event occurs. You can find it under the **Other** events. Here you can place actions. For example, you might want to destroy the instance, or let it start a new (different) path.

Time lines

In many games certain things must happen at certain moments in time. You can try to achieve this by using alarm events but when things get too complicated this won't work any more. The time line resource is meant for this. In a time line you specify which actions must happen at certain moments in time. You can use all the actions that are also available for the different events. Once you create a time line you can assign it to an instance of an object. This instance will then execute the actions at the indicated moments of time. Let us explain this with an example. Assume you want to make a guard. This guard should move 20 time steps to the left, then 10 upwards, 20 to the right, 10 downwards and then stop. To achieve this you make a time line where you start with setting a motion to the left. At moment 20 you set a motion upward, at moment 30 a motion to the right, at moment 50 a motion downwards and at moment 60 you stop the motion. Now you can assign this time line to the guard and the guard will do exactly what you planned. You can also use a time line to control your game more globally. Create an invisible controller object, create a time line that at certain moments creates enemies, and assign it to the controller object. If you start to work with it you will find out it is a very powerful concept.

To create a time line, choose **Create Time Line** from the **Resources** menu. The following form will pop up.

□

It looks a bit like the object properties form. At the left you can set the name and there are buttons to add and modify moments in the time line. Next there is the list of moments. This list specifies the moments in time steps at which assigned action(s) will happen. Then there is the familiar list of actions for the selected moment and finally there is the total set of actions available. At the left you can use the following buttons:

- **Add.** Use this to add a moment to the time line. You must indicate the moment, which is the number of steps since the time line was started. Now you can drag actions to the list as for object events.
- **Change.** Use this button to change the time steps for the currently selected moment.
- **Delete.** Use this button to delete a moment or a range of moments. You must indicate the time step of the first moment to delete and the last one. All moments in between will be deleted.
- **Clear.** Use this button to clear the entire list of moments.
- **Shift.** Use this button to shift a range of moment to a new moment. You must indicate the start of the range, the end of the range, and the new time step to which the start of the range must be shifted. When different moments become the same their action lists will be merged.
- **Duplicate.** This is almost the same as the shift button but in this case a copy of the moments are made.
- **Spread.** Use this button to spread out a range of moments by adding time between them or put them closer together by removing time between them. You specify the start and the end of the range and the percentage for the spread. A percentage of 100 means nothing changes. For values smaller than 100 the moments are moved closer together and for values larger than 100 they are moved further apart. For example if you have moments at timesteps 5, 8, and 12 and you indicate as range 5:12 and a percentage 200, the moments will move to time steps 5, 11, and 19. (The intervals between them have doubled.) When different moments become the same their action lists will be merged.
- **Merge.** Use this button to merge a number of moments into a single one. You specify the start and the end of the range and they will all be merged into the start moment.

Make sure you do not create negative time moments. They will never be executed.

There is also a button **Show Information** that shows the time line in a readable form.

There are a number of actions related to time lines. You can find them in the section on [More Main Actions](#).

Scripts

GameMaker has a built-in programming language called GML. Once you become more familiar with *GameMaker* and want to use it to its fullest extend, it is advisable to start learning to use this language. For more details in the GML language see [Part 4](#) of this documentation.

There are two ways to use the language. First of all you can create scripts. These are pieces of code to which you give a name. They are shown in the resource tree and can be saved to a file and loaded from a file. They can even be used to form a library that extends the possibilities of *GameMaker*. Alternatively, you can add a code action to some event and type a piece of code there. Adding code actions works in exactly the same way as adding scripts except for two differences. Code actions don't have a name and cannot use arguments. Also they have the well-known field to indicate to what objects the action should apply. For the rest you enter code in exactly the same way as in scripts. We recommend you to use scripts for all but simple pieces of code as *GameMaker* has many more features that deal with scripts. So we further concentrate on scripts in this chapter.

As stated before, a script is written with code in GML (the built-in programming language) and is meant to perform a particular task. Scripts can takes input-variables called arguments (sometimes called parameters). To execute a script from any event, you can use the script action. In the script action you specify the script you want to execute, together with the up to five arguments.

You can also execute a script from within a piece of code (a different script) in the same way you call a GM-function. In that case you can use up to 16 arguments. Scripts can return a value. This is often used to build calculating methods (mathematical methods). The **return** keyword is used for this. No code after the return keyword is executed! When a script returns a value, you can also use it as a function when providing values in other actions.

Scripts are extremely useful to extend the possibilities of *GameMaker*. This does though require that you design your scripts carefully. Scripts can be stored in files that can be added to your game. To import a script file, use the item **Import scripts** from the **Scripts** menu. To save your scripts in the form of a file use **Export scripts**. Script libraries are simple text files (although they have the extension .gml). Preferably don't edit them directly because they have a special structure.

To create a script in your game, choose **Create Script** from the **Resources** menu. A code editor will appear that will be described next.

The code editor

When creating or editing a script (or a code action) the following code editor form will appear (in the example we already added a little script that computed the product of the two arguments).

□

At the top right you can indicate the name of the script. You should give all of your scripts a sensible name. Make sure the name only consists of letter, digits, and the `_` symbol. It should not start with a digit. In this way you can use the script later as a function in code.

At the top you have a toolbar with some useful buttons. From left to right you have the OK button to close the editor, saving the changes, buttons to load the script from a text file, save it to a text file, and print it.

Next there are undo and redo buttons. The editor will basically remember all changes you did and you can undo them (or redo the undone changes). You can change the maximal number of undo operations in the Preferences. Here you can also indicate whether you want to group the undo operations (such that e.g. typing a line of text can be undone in one step) or that every keystroke is separate saved. You can use **<Ctrl> + Z** for undo and **<Ctrl> + <Shift> + Z** for redo.

Next to this there are buttons to cut, copy, and paste text, as you should be familiar with. The final two buttons are for finding and replacing and for code checking. These will be explained below in detail.

Below the toolbar there is the area where you can type the text. At the left there are the line numbers. (You can switch these on and off using the F9 key.) The line with the cursor on it is marked in bold. The dark red bar behind certain line numbers indicated that these lines have changed. You will notice that you can type text anywhere on the lines. So a line does not really

have an end. This tends to be useful when aligning text. There are many editing possibilities, that will be described below.

At the bottom there is the status bar. This shows from left to right the current line number, total number of lines and cursor position. Whether you are in Insert mode or Overwrite mode. (In Overwrite mode also the cursor changes to make it clear that you are overwriting the existing text.) Next there is the point size for the font used. You can use F7 and F8 to decrease or increase the font size. (You have more control over the font size and type in the Preference.)

Editing tools

The editor has many editing possibilities. Some of these can also be accessed through the pop-up menu that appears when you press the right mouse button. Here are the most important ones:

- Multiple undo and redo either per key press or in groups
- The arrow keys move you around in the text. Use **<Ctrl>** with the left and right arrow key to move to the beginning of the previous or next word. Use **<Ctrl>** with the up and down key to also scroll the text. Hold the **<Shift>** key to select text.
- Double click the line number to select the complete line.
- The Home key moves to the beginning of the line and the End key to the end of the line. With **<Ctrl>** they move to the start and end of the script. Hold the **<Shift>** key to select text.
- You can scroll through the text with the mouse wheel. With **<Ctrl>** the cursor scrolls with the text. Hold the **<Shift>** key to select text.
- Intelligent auto indent that aligns with the previous line when you use the return key of the backspace key (can be set in the preferences).
- Intelligent tabbing that tabs till the first non space in the previous lines (can be set in the preferences). Use **<TAB>** to indent *selected* lines and **<Shift> + <TAB>** to unindent *selected* lines.
- Hold **<Ctrl>** with the Backspace or Delete key to delete until the beginning of the previous or next word.
- You can drag a selection with the mouse. (Use **b><Ctrl>** to copy it.) The new location is immediately shown.
- Cut, copy and paste of text between script forms and other programs.ograms.
Use **F12** to open the script or resource whose name is at the cursor position.

Color coding

As you might have noticed, parts of the script text are colored. The editor knows about existing objects, built-in variables and functions, etc. Color- coding helps a lot in avoiding mistakes. In particular, you see immediately if you misspelled some name or use a keyword as a variable. If you don't like the color coding, in the Preferences you can switch it on and off (you can also use **F10**). In the Preferences you can also change the color for the different components of the code.

Function and variable help

contains many built-in functions and variables and you add your own resources and scripts to this. So it might be hard to remember all of them. Fortunately the editor helps you with this. When you type part of a name (at least two characters) and wait a little, a list is shown of all possibilities. For example, as follows:

□

You can continue typing and the list will adapt. You can use the up and down keys to scroll through the list and press Enter to replace the text you are typing with the selected function or variable name.

You can switch this feature on and off in the preferences. You can always force the list to appear by pressing **<Ctrl> + Space**, and you can cancel it at anytime by pressing **<ESC>**.

A second form of help is given when you are typing in the arguments for a function. In this case, in the status bar at the bottom the function with its arguments is given. The current argument you are typing is shown in bold. In this way you will never forget arguments or get the order wrong. ong.

Find and replace

It is common that you want to find some piece of text in your code or replace some text with another one. To this end you can either press the Find button in the toolbar, or press **<CTRL>+F**. A panel will show up at the right of the form, as follows:

□

You can type the find string at the top. Note that in the code all occurrences of the find string are immediately shown with a yellow background. (You can switch this off in the Preferences.) As usual you can indicate whether the search must be case sensitive (which is normally what you want as variable and function names in GML are also case sensitive) and whether you want to only search for whole words. Note that the editor remembers your most recent searches. /p>

With the buttons with the blue arrows you can now move to the previous, next, first, and last occurrence of the find string. It will be selected in the text such that you can e.g. delete it.

When you want to replace occurrences, also type a text in the replace box. Now you can use the buttons to replace the previous occurrence, the next, the first, the last, or all occurrences of the find text. Remember you can always use Undo to undo the replacements.

Code snippets

Code snippets are small pieces of code that you will often use. You can add them in the code through the snippet menu. To this end press F2. A menu appears from which you can select the snippet. It will be inserted at the cursor in your code. Some pieces consist of capital letters only. These must still be replaced by you. The first one is selected for replacement. To replace another, simply double click on it.

You can define your own code snippets if you want. The snippets are stored in the file `snippets.txt` in the folder in which GameMaker is installed. You can edit this file with any text editor. Each snippet is on a separate line and there should be no blank lines. It starts with the name of the snippet (shown in the menu) followed by the colon (:) followed by the actual snippet. Use # for a newline and put the text that needs to be selected first between | symbols. See the examples that are already in the file. (Better make a backup of it before you start changing it.)

Error checking

In the toolbar at the top there is a button with which you can switch error checking on or off. When error checking is on, GameMaker constantly tests the code you are typing and reports the first error it finds at the bottom of the window. Also the line number for the line with the error is drawn in red. You can click on the error message to go to the correct line and position to correct the error. Note that not all aspects can be tested at this stage but the syntax of your script will be tested, together with the existence of functions used.

When you start typing a script, error checking might be annoying so you can switch it off. But when the script is almost ready you better switch it on to correct all the errors. Note that also the color coding will help you catch errors. Finally, when you put your cursor at a bracket the editor will show you the corresponding opening or closing bracket. If it cannot find it, it is shown in red. (You can switch this off in the Preferences.))

Debugging

When creating scripts you can easily make mistakes. Always test the scripts by using the error checking button. However, this will not catch all errors. So you will need to run the game to test your code.

When an error occurs during the execution of a script this is reported, with an indication of the type of error, the script or action it occurs in, and the line and position. Rarely you will see a popup with the text "Unexpected error occurred during the game". This error message indicates that some problem occurred in windows or in the hardware. Often the reason for this is infinite recursion, lack of memory or insufficient hardware, drivers or firmware. Generally speaking, these errors have to do with problems outside the GameMaker environment.

If you need to check things more carefully, you can run the game in debug mode. Now a form appears in which you can monitor lots of information in your game. .

□

Under the **Run** menu you can pause the game, run it step by step and even restart it. Under the **Watch** menu you can watch the value of certain expressions. Use **Add** to type in some expression whose value is shown in each step of the game. In this way you can see whether your game is doing things the right way. You can watch many expressions. You can save them for later use (e.g. after you made a correction to the game). Under the **Tools** menu you find items to see even more information. You can see a list of all instances in the game, you can watch all global variables (well, the most important ones) and the local variables of an instance (either use the object name or the id of the instance). You can also view messages which you can send from your code using the function `show_debug_message(str)`. Finally you can give the game commands and change the speed of the game. If you make complicated games you should really learn how to use the debug options.

Extension Packages

This functionality is only available in the Standard Edition of GameMaker.

Extension packages extend the possibilities of *GameMaker*. An extension package can add a set of actions to *GameMaker* or it adds a number of additional functions and constants to the GML language built into *GameMaker*. When extension packages are available to you, help about these is placed in the **Help** menu.

When double clicking on the **Extension Packages** resource item the following form is shown:

□

In this form you can indicate which extension packages must be used in the game. On the left there is the list of **Used** packages and on the right is the list of **Available** packages. To move a package from one list to the other, simply select it and press the button between the list. When selecting a package a short description is given at the bottom. Further help is available by pressing the **Help** button.

Extension packages are an extremely powerful part of *GameMaker*. A few extension packages are provided with *GameMaker* but many more will become available through the website. To install new packages or uninstall existing ones, press the **Install** button. The following form is shown

□

You will see a list of all extension packages installed. By selecting a package and clicking the **Uninstall** button the package is removed from the system.

Install packages are distributed in the form of a .gex file. You can find a number of such packages on our website which you can go to by pressing the button **Find More**. Once you downloaded such a package file on your computer, press the **Install** button and select the package file. It will then be installed in the system.

If you want to create your own extension packages, please check out the information that is available on <http://www.yoyogames.com/extensions>.

Esportare e Importare Risorse

This functionality is only available in the Standard Edition of GameMaker.

Note: Import and export of resources is only for experienced users. Carefully read this section before using these features. Also, always make a back-up copy of your game before importing resources.

Sometimes you want to copy certain resources (sprites, sounds, rooms, etc.) from one game to another game. For example when you want to create a new game using the same sprites and sounds as another game. Or when you are working together on a game. One of you might have created some additional rooms that you then want to import in the other game. To this end *GameMaker* has commands to import and export resources.

Exporting resources

To export resources, choose **Export Resources** from the **File** menu. First of all it is checked whether all resources have different names. Because resources in one game are linked to the ones in the other game by name, it is essential that all resources have different names. If not, you get an error message and no resources can be exported. Otherwise, a file selector is shown in which you can indicate the name of the file in which you want to export the resources. These files must end with the extension `.gmres`. Next the following form is shown:

□

In this form you can indicate which resources must be exported. Default all are exported but you can select the particular types of resources you want to export. Care must be taken when exporting objects, timelines, or rooms. These will refer to sprites, sounds, triggers, etc. So if you do not export these other resources as well you must be certain that these other resources already exist in the game in which you are going to import the resources (under the same names). If you are uncertain, better export everything.

Importing resources

Once you have a file containing resources you can import them in a different game by choosing **Import Resources** from the **File** menu. First of all it is checked whether all resources have different names. Again, because resources in one game are linked to the ones in the other game by name, it is essential that all resources have different names. If not, you get an error message and no resources can be imported. Otherwise, a file selector is shown in which you can indicate the name of the file from which you want to import the resources. These files will end with the extension `.gmres`. Next all open property forms are closed. This is necessary because imported resources might replace existing ones. Next the following form is shown:

□

All types of resources in the file are shown. (The ones that were not exported and grayed out.) You can select which of these resources you want to import. Most of the time you want to import all but sometimes you want to make a selection. Be careful when importing objects, rooms, or timelines while not importing other resources. As indicated above this can lead to problems if the resources they refer to do not exist in your game under the same name. In such a case they will be replaced by non-existing resources. (For example, in the rooms it means the corresponding instances will be removed.)

When resources in the file have the same name as resources in the game a naming conflict appears. You can indicate how that should be resolved. The default is that you keep the resource that was changed last. You can however also choose to always keep the original in the game or always replace it with the resource in the file. A fourth option is to keep both. Only use this when it is absolutely necessary, because you will now end up with multiple resources with the same name which can lead to conflicts when referring to them. When you import resources into an empty game, better choose to always replace them. (This may sound strange but for example otherwise the global game settings will not be replaced as the new empty game is of a more recent date!)

Finally you can indicate whether to place the new resources (that is, the ones that do not already occur) in a new group. This might be useful to distinguish (visually) the imported resources from the existing ones. If you check this box the new resources will be placed in a group. The name of this group is the name of the import file.

Once you press **OK** the resources are added to the game, replacing existing resources with the same name when required.

You will see them appear in the resource selector at the left.

Warnings and Remarks

Importing and exporting resources is a powerful mechanism, in particular when you are working on a game with multiple people. However, if you do not understand what you are doing it might lead to errors and frustration. Here are some important warnings that you should read and understand.

- Always make a backup copy of your game before importing resources. Otherwise your hard work might be lost. You cannot undo the import of resources.
- Always check after an import whether everything was imported correctly. Also immediately run the game to see if it all works. Otherwise return to your backup copy.
- Note that the indices of resources, instances, and tiles, most likely change in the process to guarantee that they remain unique. This will cause problems when you refer to resources (or instances) by number. Also it will cause problems if you assume anything about the order in which instances are created.
- Note that the resources will be added in the order in which they are given in the resource list/tree. New resources will be added at the end. However, the group structure is maintained. This is normally what you expect but in some rare cases you might have to move resources to a different location. For example, when you have a start room, an end room and some rooms in between, when somebody adds some rooms (in between) and you then export these and import them in the original game, they will appear at the end (because they are new). You then must move the end room to the appropriate location again.!
- Note that constants and triggers only globally store information about when they were last changed. So when you change one constant or one trigger, all will be replaced when choosing **Keep Last Changed**.
- For the global game settings the same holds. They are either all, or not at all replaced.
- Note that an empty game will have a new date at which it was last changed. This means that if you import resources in a new empty game, the constants, triggers, and global game settings will **not** be imported, unless you set the name conflict handling to always replace.
- Don't remove resources from a game before importing the same resources again! This might sound a logical thing to do but it will not work. Once you remove a resource from a game it no longer exists. Hence all references to it will become undefined. Importing the same resource later will not restore those references because the program cannot know it is the same resource. Instead let the import feature replace the resources.
- If you have worked on a game for a long time adding and deleting many resources, it is useful to completely export it and then import it into an empty game (with the option to always replace). The game will work as before but will be stripped of lots of unused data.

Migliorando il tuo gioco

Quando vuoi distribuire il tuo gioco Ã meglio che sei sicuro che ha tutti gli ingredienti per fare un gran gioco. Oltre al gioco stesso questo intende che dovresti fornire le informazioni di gioco, settare le corrette impostazioni globali del gioco, e tenere conto della velocitÃ . Questa sezione ti da' le informazioni su questi aspetti.

Informazioni sul completamento del tuo gioco possono essere trovate nelle seguenti pagine:

[Informazioni del gioco](#)

[Impostazioni Globali del Gioco](#)

[Considerazioni sulle prestazioni](#)

Informazioni del gioco

Un buon gioco fornisce al giocatore alcune informazioni su come giocare al gioco. Queste informazioni sono visualizzate quando il giocatore preme il tasto <F1> durante il gioco. *GameMaker* ha un semplice meccanismo incorporato che fornisce un aiuto di gioco. Comunque, Ã¨ limitata in funzionalit . Per creare ottimi giochi Ã¨ meglio crearsi l'aiuto da soli usando stanze speciali o usando una schermata iniziale, ad esempio pagine html.

Per creare semplici informazioni di gioco, fai doppio click su **Game Information** nell'albero delle risorse alla sinistra dello schermo. Un piccolo editor incorporato verr  aperto dove puoi editare le informazioni del gioco. Puoi usare tipi diversi di carattere, colori diversi, e stili. Puoi anche impostare il colore di sfondo.

□

Nel menu **File** puoi anche impostare un numero di **Opzioni**. Di default l'aiuto Ã¨ visualizzato nella finestra del gioco e il gioco Ã¨ temporaneamente arrestato. Qui puoi indicare di visualizzare il file d'aiuto in una finestra separata. In questo caso puoi indicare la didascalia delle informazioni durante il gioco. Puoi anche indicare la posizione (usa -1 per centrare) e la dimensione della finestra delle informazioni del gioco e quando dovrebbe avere un bordo ed essere ridimensionabile dal giocatore. Puoi anche forzare la finestra delle informazioni per rimanere in cima e puoi indicare quando il gioco dovrebbe continuare a giocare finch  le informazioni sono visualizzate.

Buona nota per creare le informazioni Ã¨ essere piccole ma precise. Certamente dovrei aggiungere il tuo nome perch  hai creato il gioco. Tutti i giochi d'esempio sono forniti di un file di informazioni sul gioco e di chi lo ha creato. (Potresti voler indicare alla fine del file d'aiuto che l'utente deve premere Escape per continuare a giocare).

Se vuoi creare con un po' pi  di fantasia l'help, usa un programma come Word. Poi seleziona la parte che vuoi e usa copia e incolla per muoverlo da Word all'editor delle informazioni del gioco. Anche se per altri giochi avanzati, probabilmente non usare questo meccanismo come tutti ma userai qualche stanza dedicata per visualizzare l'aiuto sul gioco.

Impostazioni Globali del Gioco

Ci sono delle impostazioni che puoi cambiare per il tuo gioco. Queste cambiano la forma della finestra principale, impostano alcune opzioni grafiche, trattano con le impostazioni di interazione, per caricare immagini, costanti e altre informazioni riguardo al creatore del gioco. Ti permettono anche di indicare quali files devono essere inclusi e quali errori devono essere trattati.

Le impostazioni possono essere cambiate con un doppio click su **Global Game Settings** nell'albero delle risorse a sinistra dello schermo. Esse sono suddivise in un numero di pagine a schede. (Alcune opzioni sono disponibili solo nell'advanced mode.)

Le informazioni riguardo alle differenti impostazioni si trovano in queste pagine:

[Impostazioni sulla Grafica e sulle Finestre](#)

[La Risoluzione dello Schermo](#)

[Varie Altre Opzioni](#)

[Opzioni di Caricamento](#)

[Opzioni sugli Errori](#)

[Informazioni riguardo al Gioco](#)

Impostazioni sulla Grafica e sulle Finestre

In questa scheda puoi impostare un numero di opzioni riguardanti l'aspetto grafico del tuo gioco. È normalmente utile controllare gli effetti di queste opzioni perché possono avere un effetto significativo nel modo in cui il gioco appare. Ricorda che differenti utenti hanno delle differenti macchine. Quindi è meglio assicurarsi che le impostazioni funzionano anche sulle macchine degli altri.

Start in fullscreen mode

Quando è selezionato il gioco parte in full screen (a schermo intero); altrimenti parte in una finestra.

Scaling

Qui puoi indicare cosa succede quando la finestra è più grande della room o quando il gioco viene eseguito in modalità full-screen. Ci sono tre scelte. Puoi indicare una dimensione fissa (fixed scaling). La room verrà disegnata ridimensionata con la quantità inserita al centro della finestra o al centro dello schermo. 100 indica che non verrà ridimensionata. Di solito devi usare la dimensione fissa quando i tuoi sprites e le tue rooms sono molto piccoli. La seconda opzione ridimensiona la room in modo che riempie la finestra o lo schermo, ma mantiene l'aspect ratio (il rapporto tra larghezza e altezza) uguale. La terza opzione ridimensiona in modo che la finestra o lo schermo sia completamente riempita. Questa opzione può provocare distorsioni nell'immagine (in particolare nella modalità finestra quando l'utente la ridimensiona).

Interpolate colors between pixels

Quando viene selezionata, i colori dei pixels negli sprites, background e tiles che non sono allineati con i pixel nello schermo verranno interpolati. Questo in particolare è il caso quando essi vengono ruotati, ridimensionati o piazzati in posizioni non intere. L'interpolazione rende i movimenti più morbidi, ma potrebbe anche dare un effetto sfocato. (Anche per le tiles può provocare delle fratture tra di esse, se non correttamente progettate.)

Color outside the room region

Quando la room non riempie completamente la finestra o lo schermo c'è dell'area inusata attorno ad esso. Qui puoi scegliere il colore di quest'area.

Allow the player to resize the game window

Quando viene selezionata questa opzione nella modalità finestra l'utente può cambiare la dimensione della finestra trascinando col mouse i suoi bordi.

Let the game window always stay on top

Quando viene selezionata in modalità finestra, questa rimane sempre sopra rispetto alle altre finestre.

Don't draw a border in windowed mode

Quando viene selezionata in modalità finestra, questa non avrà né bordo né barra del titolo.

Don't show the buttons in the window caption

Quando viene selezionata in modalità finestra, questa non avrà i bottoni della barra del titolo per chiudere la finestra, minimizzarla o massimizzarla.

Display the cursor

Indica se mostrare il puntatore del mouse. Disattivandolo è normalmente più veloce. (Puoi facilmente creare il tuo oggetto cursore in *GameMaker*.)

Freeze the game when the form loses focus

Quando viene selezionata, se il giocatore porta altre finestre sopra quella del gioco (per esempio un'altra applicazione) il gioco si congelerà finché la finestra del gioco riavrà il focus.

Disable screensavers and power saving actions

Quando viene selezionata (gli screensavers e le azioni di risparmio energetico (come l'ibernazione) non verranno attivate mentre il gioco è in esecuzione. Questo è importante perché queste potrebbero distruggere alcuni aspetti grafici del gioco (come le surfaces).

Resolution

In this tab you can set the screen resolution in which your game must run. By default the resolution is not changed. But sometimes you want to run the game in a lower resolutions or you want to set the frequency of the monitor to make sure the timing in the game works correctly. If you want to change the resolution you must first check the box labeled **Set the resolution of the screen**.

There are three things you can change. First of all there is the color depth. This indicates the number of bits used to represent the color for a pixel. Most machines now only allow for 16-bit (High Color) or 32-bit (Full Color) but older machines also allowed for 8-bit and sometimes 24-bit color. *GameMaker* only works correctly in 16-bit and 32-bit color. 32-bit color gives nicer looking images but will take more memory and processing time. If you want your game to run well on most older machines set the color depth to 16-bit. Otherwise use 32-bit or don't change it.

Secondly there is the screen resolution, the number of pixels (horizontal and vertical) on the screen. Changing the resolution is useful when e.g. your rooms are very small. In this case it might help to reduce the resolution of the screen. Realize though that this will also effect other applications running. This can in particular give problems with low resolutions. So in general it is better to only do this when running the game in full screen mode. *GameMaker* will automatically change the resolution back to the starting situation once the game finishes.

Finally you can change the refresh frequency. This indicates how many times per second the image on the screen is refreshed. If your room speed is larger than the frequency not all steps are actually visible. It works best if the frequency is a multiple of the room speed. (If you specify a frequency that is too high or not available the frequency is not changed.)

There also is a setting here to **Use synchronization to avoid tearing**. This requires some explanation. A display is redrawn a number of times per second, depending on the refresh frequency. If a room is drawn halfway such a refresh, the top of the display will still show the old image while the bottom part shows the new image. This is called tearing. To avoid this you can check this option. In this case the new room image is only copied to the screen when the refresh is not inside the window avoiding the tearing most of the time. The disadvantage is that we normally have to wait till the next refresh. This means that the maximal number of frames is bounded by the frequency of the monitor and, when the processing is not fast enough, the framerate immediately drops to half that number. Also there can be a conflict between the internal timing of the game and the synchronization. If you want to do this best set the monitor frequency to e.g. 60 and also make the room speed either 30 or 60.

Varie Altre Opzioni

Here you can set a number of additional options. First of all you can set some default keys:

Let <Esc> end the game

When checked, pressing the escape key will end the game. More advanced games normally don't want this to happen because they might want to do some processing (like saving) before ending the game. In this case, uncheck this box and provide your own actions for the escape key.

Treat the close button as <Esc> key

When checked the close button of the window will generate an escape key event. When not checked the close button events are called instead.

Let <F1> show the game information

When checked pressing the F1 key will display the game information.

Let <F4> switch between screen modes

When checked the F4 key will switch between fullscreen and windowed mode.

Let <F5> save the game and <F6> load a game

When checked the player can use <F5> to store the current game situation and <F6> to load the last saved game. (Note that only the basic game data is stored. Once you use advanced features like particles or data structures those settings are not saved and you might have to create a save mechanism yourself.

Let <F9> take a screenshot of a game

When checked the player can use <F9> to create a screenshot of the game. This screenshot will be placed in the file screenshotXXX.png in the folder where the game is running, where XXX is the number of the screenshot. When creating multiple screenshots the number is automatically increased.

Also you can set the priority of the game process. This priority indicates how much processor time is allotted to the game. In normal mode the operating system tries to give processor time to each process that needs it in some reasonable way. The higher you put the priority the more time is allotted to the game, making it run more smoothly and faster. But other processes get less time (also Windows processes so even the mouse might not move anymore). Use this with care.

Finally, you can set the version information of the game. This information is shown in the helptip that pops up when the user rests his mouse on the game executable. It is also shown when the user clicks with the right mouse button on the program and chooses properties and then version. If you distribute your game you best fill in this information.

You should give your game a version number that consists of four parts: the major version, the minor version, the release number and the build number. Also you should provide the name of the company (you), the name of the product, the copyright information, and a very brief description. All these fields should be at most 64 characters long.

Loading options

Here you can indicate what should happen when loading a game. First of all you can specify your own loading image. Secondly, you can indicate whether to display a loading progress bar at the bottom of the image. You have three options here. Either no loading bar is displayed, or the default bar is displayed or you can specify two images: the background of the loading bar and the foreground. You can indicate whether the front loading bar must be scaled (default) or clipped while it becomes longer. In the second case, make sure enough the image is large enough to fill the bar. (Note that both images must be specified in this case, not just one.)

It is possible to indicate that the loading image must be transparent. In this case the left bottom pixel of the background image is used as transparent color. (Note that transparency from e.g. png or gif files is not taken into account here!) Also the alpha translucency can be indicated. A value of 0 means fully translucent. A value of 255 means fully opaque. (Both only work under Windows 2000, XP, o successivi.)

Secondly, you can indicate here the icon that should be used for stand-alone games. Your icons must contain at least a 32x32 icon, but they can also contain larger ones. If you try to select another type of icon you will get a warning.

Infine puoi cambiare l'id del gioco. Questo id Ã© usato per storing the highscore list and save game files. If you release a new version of your game and don't want to take over the old highscore list, you should change this number.

Opzioni sugli Errori

Here you can set a number of options that relate to the way errors are reported.

Display error messages

When checked, error messages are shown to the player. In the final version of the game you might want to uncheck this option.

Write error messages to file `game_errors.log`

When checked all error messages are written to a file called `game_errors.log` in the game folder.

Abort on all error messages

Normally, certain errors are fatal while others can be ignored. When checking this option all errors are considered fatal and lead to aborting the game. In the final version of the game you distribute you might want to check this option.

Treat uninitialized variables as 0

One common error is to use a variable before a value is assigned to it. Sometimes this is difficult to avoid. When checking this option such uninitialized variables no longer report an error but are treated as value 0. Be careful though. It might mean that you don't spot typing mistakes anymore.

Information about the game

Here you can indicate the author of the game, the version of the game, and some information about the game. Also the last changed date is maintained. This is useful if you are working with many people on a game or make new, updated version. The information is not accessible when the game is running.

Considerazioni sulle prestazioni

If you are making complicated games you probably want to make them run as fast as possible. Even though *GameMaker* does its best to make games run fast, a lot depends on how you design your game. Also, it is rather easy to make games that use large amounts of memory. In this page we give some hints on how to make your games faster and smaller.

First of all, look carefully at the sprites and backgrounds you use. Animated sprites take a lot of memory and drawing lots of sprites takes a lot of time. So make your sprites as small as possible. Remove any invisible area around it (the command **Crop** in the sprite editor does that automatically). The same applies to background images. If you have a covering background, make sure you switch off the use of a background color.

If you use full screen mode, make sure the size of the room (or window) is never larger than the screen size. Most graphics cards can efficiently scale images up but they are more slow in scaling images down! Whenever possible, switch off the cursor. It slows down the graphics.

Also be careful with the use of many views. For each view the room is redrawn.

Besides the graphics, there are also other aspects that influence the speed. Make sure you have as few instances as possible. In particular, destroy instances once they are no longer required (e.g. when they leave the room). Avoid lots of work in the step event or drawing event of instances. Often things do not need to be checked in each step. Interpretation of code is reasonably fast, but it is interpreted. Also, some functions and actions take a lot of time; in particular those that have to check all instances (like for example the bounce action).

When you need complicated processing (for example for advanced AI), you better write a DLL for this in a different language and create an extension package out of this to import the DLL using the functions described in the page on [Using DLL's](#).

Think about where to treat the collision events. You normally have two options. Objects that have no collision events are treated much faster, so preferably treat collisions in those objects of which there are just a few instances.

Be careful with using large sound files. They take a lot of memory and also compress badly. You might want to check your sounds and see whether you can sample them down.

Finally, if you want to make a game that many people can play, make sure you test it on a number of different machines, in particular also older machines.

Il Linguaggio di Game Maker (GML)

GameMaker contiene un linguaggio di programmazione incorporato. Questo linguaggio di programmazione da' maggiore flessibilit  e controlla le azioni standard. Questo linguaggio che noi riferiremo come GML (il Linguaggio Game Maker). In questa sezione descriveremo il linguaggio GML e daremo una panoramica di tutte le (fissate a 1000) funzioni e variabili disponibili per controllare tutti gli aspetti del tuo gioco.

Informazioni sul GML possono essere trovate nelle seguente pagine:

- [Panoramica del linguaggio](#)
- [Calcolando le cose](#)
- [Game play](#)
- [Interazione Utente](#)
- [Grafica](#)
- [Souni e musica](#)
- [Schermate iniziali, classifiche e altri pop-ups](#)
- [Risorse](#)
- [Cambiando le risorse](#)
- [Files, registro, esecuzione programmi e device specifico](#)
- [Strutture dati](#)
- [Creare particelle](#)
- [Giochi multiplayer](#)
- [Usare le DLL](#)
- [Grafica 3D](#)

GML Language overview

GameMaker contains a built-in programming language. This programming language gives you much more flexibility and control than the standard actions. This language we will refer to as GML (the *GameMaker* Language). There are a number of different places where you can type programs in this language. First of all, when you define scripts. A script is a program in GML. Secondly, when you add a code action to an event. In a code action you again have to provide a program in GML. Thirdly, in the room creation code. And finally, wherever you need to specify a value in an action, you can also use an expression in GML. An expression, as we will see below is not a complete program, but a piece of code resulting in a value.

In this chapter we will describe the basic structure of programs in GML. When you want to use programs in GML, there are a couple of things you have to be careful about. First of all, for all your resources (sprites, objects, sounds, etc.) you must use names that start with a letter and only consist of letters, digits and the underscore '_' symbol. Otherwise you cannot refer to them from within the program. Make sure all resources have different names. Also be careful not to name resources self, other, global, or all because these have special meaning in the language. Also you should not use any of the keywords, indicated below.

Information on the GML language can be found in the following pages:

- [A Program](#)
- [Variables](#)
- [Assignments](#)
- [Expressions](#)
- [Extra Variables](#)
- [Addressing Variables in Other Instances](#)
- [Arrays](#)
- [If Statement](#)
- [Repeat Statement](#)
- [While Statement](#)
- [Do Statement](#)
- [For Statement](#)
- [Switch Statement](#)
- [Break Statement](#)
- [Continue Statement](#)
- [Exit Statement](#)
- [Functions](#)
- [Scripts](#)
- [With Construction](#)
- [Comment](#)
- [Functions and Variables in GML](#)

A Program

A Program consists of a set of instructions, called statements. A program must start with the symbol '{' and end with the symbol '}'. Between these symbols there are the statements. Statements must be separated with a ';' symbol. So the global structure of every program is:

```
{  
    <statement>;  
    <statement>;  
    . . .  
}
```

There are a number of different types of statements, which will be discussed below.

Variables

Like any programming language GML contains variables. Variables are memory locations that store information. They have a name so that you can refer to them. A variable in GML can store either a real number or a string. Variables do not need to be declared like in many other languages. There are a large number of built-in variables. Some are general, like `mouse_x` and `mouse_y` that indicate the current mouse position, while all others are local to the object instance for which we execute the program, like `x` and `y` that indicate the current position of the instance. A variable has a name that must start with a letter and can contain only letters, numbers, and the underscore symbol '_'. (The maximal length is 64 symbols.) When you use a new variable it is local to the current instance and is not known in programs for other instances (even of the same object). You can though refer to variables in other instances; see below.

Assignments

An assignment stores a value in a variable. An assignment has the form:

```
<variable> = <expression>;
```

An expression can be a simple value but can also be more complicated. Rather than assigning a value to a variable, one can also add the value to the current value of the variable using `+=`. Similar, you can subtract it using `-=`, multiply it using `*=`, divide it using `/=`, or use bitwise operators using `|=`, `&=`, or `^=`.

Expressions

Expressions can be real numbers (e.g. 3.4), hexadecimal numbers, starting with a \$ sign (e.g. \$00FFAA), strings between single or double quotes (e.g. 'hello' or "hello") or more complicated expressions. (Note that strings can run over multiple lines!) For expressions, the following binary operators exist (in order of priority):

- && || ^: combine Boolean values (&& = and, || = or, ^ = xor)
- < <= == != > >=: comparisons, result in true (1) or false (0)
- | & ^: bitwise operators (| = bitwise or, & = bitwise and, ^ = bitwise xor)
- << >>: bitwise operators (<< = shift left, >> = shift right)
- + -: addition, subtraction
- * / div mod: multiplication, division, integer division, and modulo

Note that value of `x div y` is the value of `x/y` rounded in the direction of zero to the nearest integer. The `mod` operator returns the remainder obtained by dividing its operands. In other words, `x mod y = x - (x div y) * y`. Also, the following unary operators exist:

- !: not, turns true into false and false into true
- -: negates the next value
- ~: negates the next value bitwise

As values you can use numbers, variables, or functions that return a value. Sub-expressions can be placed between brackets. All operators work for real values. Comparisons also work for strings and + concatenates strings. (Please note that, contrary to certain languages, both arguments to a Boolean operation are always computed, even when the first argument already determines the outcome.)

Example

Here is an example with some assignments.

```
{
  x = 23;
  color = $FFAA00;
  str = 'hello world';
  y += 5;
  x *= y;
  x = y << 2;
  x = 23*((2+4) / sin(y));
  str = 'hello' + " world";
  b = (x < 5) && !(x==2 || x==4);
}
```

Extra Variables

You create new variables by assigning a value to them (no need to declare them first). If you simply use a variable name, the variable will be stored with the current object instance only. So don't expect to find it when dealing with another object (or another instance of the same object) later. You can also set and read variables in other objects by putting the object name with a dot before the variable name.

To create global variables, that are visible to all object instances, precede them with the word `global` and a dot. So for example you can write:

```
{
  if (global.doit)
  {
    // do something
    global.doit = false;
  }
}
```

Alternatively you can declare the variables as being global. This declaration looks as follows.

```
globalvar <varname1>,<varname2>,<varname3>, ... ;
```

Once this declaration has been executed, the variable is always treated as global without the need to put the word `global` and a dot in front of it. It only needs to be declared once in a piece of code that is executed. After that in all other places the variable is considered as being global.

Sometimes you want variables only within the current piece of code or script. In this way you avoid wasting memory and you are sure there is no naming conflict. It is also faster than using global variables. To achieve this you must declare the variables at the beginning of the piece of code using the keyword `var`. This declaration looks as follows.

```
var <varname1>,<varname2>,<varname3>, ... ;
```

For example, you can write:

```
{
  var xx,yy;
  xx = x+10;
  yy = y+10;
  instance_create(xx,yy,ball);
}
```

Addressing variables in other instances

As described earlier, you can set variables in the current instance using statements like

```
x = 3;
```

But in a number of cases you want to address variables in another instance. For example, you might want to stop the motion of all balls, or you might want to move the main character to a particular position, or, in the case of a collision, you might want to set the sprite for the other instance involved. This can be achieved by preceding the variable name with the name of an object and a dot. So for example, you can write

```
ball.speed = 0;
```

This will change the speed of all instances of object ball. There are a number of special "objects".

- **self:** The current instance for which we are executing the action
- **other:** The other instance involved in a collision event
- **all:** All instances
- **noone:** No instance at all (sounds weird probably but it does come in handy as we will see later on)
- **global:** Not an instance at all, but a container that stores global variables

So, for example, you can use the following kind of statements:

```
other.sprite_index = sprite5;  
all.speed = 0;  
global.message = 'A good result';  
global.x = ball.x;
```

Now you might wonder what the last assignment does when there are multiple balls. Well, the first one is taken and its x value is assigned to the global value.

But what if you want to set the speed of one particular ball, rather than all balls? This is slightly more difficult. Each instance has a unique id. When you put instances in a room in the designer, this instance id is shown when you rest the mouse on the instance. These are numbers larger than or equal to 100000. Such a number you can also use as the left-hand side of the dot. But be careful. The dot will get interpreted as the decimal dot in the number. To avoid this, put brackets around it. So for example, assuming the id of the ball is 100032, you can write:

```
(100032).speed = 0;
```

When you create an instance in the program, the call returns the id. So a valid piece of program is

```
{  
    nnn = instance_create(100,100,ball);  
    nnn.speed = 8;  
}
```

This creates a ball and sets its speed. Note that we assigned the instance id to a variable and used this variable as indication in front of the dot. This is completely valid. Let us try to make this more precise. A dot is actually an operator. It takes a value as left operand and a variable (address) as right operand, and returns the address of this particular variable in the indicated object or instance. All the object names, and the special objects indicated above simply represent values and these can be dealt with like any value. For example, the following program is valid:

```
{  
    obj[0] = ball;  
    obj[1] = flag;  
    obj[0].alarm[4] = 12;
```

```
obj[1].id.x = 12;  
}
```

The last statement should be read as follows. We take the id of the first flag. For the instance with that id we set the x coordinate to 12.

Object names, the special objects, and the instance id's can also be used in a number of functions. They are actually treated as constants in the programs.

Arrays

You can use 1- and 2-dimensional arrays in GML. Simply put the index between square brackets for a 1-dimensional array, and the two indices with a comma between them for 2-dimensional arrays. At the moment you use an index the array is generated. Each array runs from index 0. So be careful with using large indices because memory for a large array will be reserved. Never use negative indices. The system puts a limit of 32000 on each index and 1000000 on the total size. So for example you can write the following:

```
{  
    a[0] = 1;  
    i = 1;  
    while (i < 10) { a[i] = 2*a[i-1]; i += 1;}  
    b[4,6] = 32;  
}
```

If Statement

An if statement has the form

```
if (<expression>) <statement>
```

or

```
if (<expression>) <statement> else <statement>
```

The statement can also be a block. The expression will be evaluated. If the (rounded) value is ≤ 0 (**false**) the statement after else is executed, otherwise (**true**) the other statement is executed. It is a good habit to always put curly brackets around the statements in the if statement. So best use

```
if (<expression>)
{
    <statement>
}
else
{
    <statement>
}
```

Example

The following program moves the object toward the middle of the screen.

```
{
    if (x<200) {x += 4} else {x -= 4};
}
```

Repeat Statement

A repeat statement has the form

```
repeat (<expression>) <statement>
```

The statement is repeated the number of times indicated by the rounded value of the expression.

Example

The following program creates five balls at random positions.

```
{  
    repeat (5) instance_create(random(400),random(400),ball);  
}
```


While Statement

A while statement has the form

```
while (<expression>) <statement>
```

As long as the expression is true, the statement (which can also be a block) is executed. Be careful with your while loops. You can easily make them loop forever, in which case your game will hang and not react to any user input anymore.

Example

The following program tries to place the current object at a free position (this is about the same as the action to move an object to a random position).

```
{  
    while (!place_free(x,y))  
    {  
        x = random(room_width);  
        y = random(room_height);  
    }  
}
```

Do Statement

A do statement has the form

```
do <statement> until (<expression>)
```

The statement (which can also be a block) is executed until the expression is true. The statement is executed at least once. Be careful with your do loops. You can easily make them loop forever, in which case your game will hang and not react to any user input anymore.

Example

The following program tries to place the current object at a free position (this is about the same as the action to move an object to a random position).

```
{  
  do  
  {  
    x = random(room_width);  
    y = random(room_height);  
  }  
  until (place_free(x,y))  
}
```

For Statement

A for statement has the form

```
for (<statement1> ; <expression> ;<statement2>) <statement3>
```

This works as follows. First statement1 is executed. Then the expression is evaluated. If it is true, statement 3 is executed; then statement 2 and then the expression is evaluated again. This continues until the expression is false.

This may sound complicated. You should interpret this as follows. The first statement initializes the for-loop. The expression tests whether the loop should be ended. Statement2 is the step statement that goes to the next loop evaluation.

The most common use is to have a counter run through some range.

Example

The following program initializes an array of length 10 with the values 1- 10.

```
{  
  for (i=0; i<=9; i+=1) list[i] = i+1;  
}
```

Switch Statement

In a number of situations you want to let your action depend on a particular value. You can do this using a number of if statements but it is easier to use the switch statement. A switch statement has the following form:

```
switch (<expression>)
{
    case <expression1>: <statement1>; ... ; break;
    case <expression2>: <statement2>; ... ; break;
    ...
    default: <statement>; ...
}
```

This works as follows. First the expression is executed. Next it is compared with the results of the different expressions after the case statements. The execution continues after the first case statement with the correct value, until a break statement is encountered. If no case statement has the right value, execution is continued after the default statement. (It is not required to have a default statement.) Note that multiple case statements can be placed for the same statement. Also, the break is not required. If there is no break statement the execution simply continues with the code for the next case statement.

Example

The following program takes action based on a key that is pressed.

```
switch (keyboard_key)
{
    case vk_left:
    case vk_numpad4:
        x -= 4; break;
    case vk_right:
    case vk_numpad6:
        x += 4; break;
}
```

Break Statement

The break statement has the form

```
break
```

If used within a for-loop, a while-loop, a repeat-loop, a switch statement, or a with statement, it ends this loop or statement. If used outside such a statement it ends the program (not the game).

Continue statement

The continue statement has the form

```
continue
```

If used within a for-loop, a while-loop, a repeat-loop, or a with statement, it continues with the next value for the loop or with statement.

Exit Statement

La Exit Statement ha la forma

```
exit
```

Esso semplicemente termina l'esecuzione dello script o del pezzo di codice. (Non termina l'esecuzione del gioco! Per questo ti serve la funzione `game_end()`; vedi sotto.)

Functions

A function has the form of a function name, followed by zero or more arguments between brackets, separated by commas.

```
<function>(<arg1>,<arg2>,...)
```

There are two types of functions. First of all, there is a huge collection of built-in functions, to control all aspects of your game. Secondly, any script you define in your game can be used as a function.

Note that for a function without arguments you still need to use the brackets. Some functions return values and can be used in expressions. Others simply execute commands.

Note that it is impossible to use a function as the lefthand side of an assignment. For example, you cannot write `instance_nearest(x,y,obj).speed = 0`. Instead you must write `(instance_nearest(x,y,obj)).speed = 0`.

Scripts

When you create a script, you want to access the arguments passed to it (either when using the script action, or when calling the script as a function from a program (or from another, or even the same script). These arguments are stored in the variables `argument0`, `argument1`, ..., `argument15`. So there can be at most 16 arguments. (Note that when calling the script from an action, only the first 5 arguments can be specified.) You can also use `argument[0]` etc.

Scripts can also return a value, so that they can be used in expressions. For this end you use the return statement:

```
return <expression>
```

Execution of the script ends at the return statement!

Example

Here is the definition for a little script that computes the square of the argument:

```
{  
    return (argument0*argument0);  
}
```

To call a script from within a piece of code, just act the same way as when calling functions. That is, write the script name with the argument values in parentheses.

With Construction

As indicated before, it is possible to read and change the value of variables in other instances. But in a number of cases you want to do a lot more with other instances. For example, imagine that you want to move all balls 8 pixels down. You might think that this is achieved by the following piece of code

```
ball.y = ball.y + 8;
```

But this is not correct. The right side of the assignment gets the value of the y-coordinate of the first ball and adds 8 to it. Next this new value is set as y-coordinate of all balls. So the result is that all balls get the same y-coordinate. The statement

```
ball.y += 8;
```

will have exactly the same effect because it is simply an abbreviation of the first statement. So how do we achieve this? For this purpose there is the **with** statement. Its global form is

```
with (<expression>) <statement>
```

<expression> indicates one or more instances. For this you can use an instance id, the name of an object (to indicate all instances of this object) or one of the special objects (all, self, other, noone). <statement> is now executed for each of the indicated instances, as if that instance is the current (self) instance. So, to move all balls 8 pixels down, you can type.

```
with (ball) y += 8;
```

If you want to execute multiple statements, put curly brackets around them. So for example, to move all balls to a random position, you can use

```
with (ball)
{
    x = random(room_width);
    y = random(room_height);
}
```

Note that, within the statement(s), the indicated instance has become the self instance. Within the statements the original self instance has become the other instance. So for example, to move all balls to the position of the current instance, you can type

```
with (ball)
{
    x = other.x;
    y = other.y;
}
```

Use of the with statement is extremely powerful. Let me give a few more examples. To destroy all balls you type

```
with (ball) instance_destroy();
```

If a bomb explodes and you want to destroy all instances close by you can use

```
with (all)
{
    if (distance_to_object(other) < 50) instance_destroy();
}
```

Comment

You can add comment to your programs. Everything on a line after `//` is not read. You can also make a multi-line comment by placing the text between `/*` and `*/`. (Colorcoding might not work correctly here! Press F12 to re- colorcode the text if an error occurs.)

Functions and variables in GML

GML contains a large number of built-in functions and variables. With these you can control any part of the game. For all actions there are corresponding functions so you actually don't need to use any actions if you prefer using code. But there are many more functions and variables that control aspects of the game that cannot be used with actions only. So if you want to make advanced games you are strongly advised to read through the following chapters to get an overview of all that is possible. Please note that these variables and functions can also be used when providing values for actions. So even if you don't plan on using code or writing scripts, you will still benefit from this information.

The following convention is used below. Variable names marked with a * are read-only, that is, their value cannot be changed. Variable names with [0..n] after them are arrays. The range of possible indices is given.

Computing things

GameMaker contains a large number of functions to compute certain things. Here is a complete list.

Information on the GML language can be found in the following pages:

[Constants](#)

[Real-valued functions](#)

[String handling functions](#)

[Dealing with dates and time](#)

Costanti

Esistono le seguenti costanti matematiche:

true Uguale a 1.

false Uguale a 0.

pi Uguale 3.1415...

Real-valued functions

The following functions exist that deal with real numbers.

random(x) Returns a random real number between 0 and x. The number is always smaller than x.

random_range(x1,x2) Returns a random real number between x1 (inclusive) and x2 (exclusive).

irandom(x) Returns a random integer number between 0 and x (inclusive when x is an integer).

irandom_range(x1,x2) Returns a random real number between x1 (inclusive) and x2 (inclusive). Both x1 and x2 must be integer values (otherwise they are rounded down).

random_set_seed(seed) Sets the seed (an integer) that is used for the random number generation. Can be used to repeat the same random sequence. (Note though that also some actions and the system itself uses random numbers.)

random_get_seed() Returns the current seed.

randomize() Sets the seed to a random number.

choose(val1,val2,val3,...) Returns one of the arguments chosen randomly. The function can have up to 16 arguments.

abs(x) Returns the absolute value of x.

sign(x) Returns the sign of x (-1, 0 or 1).

round(x) Returns x rounded to the nearest integer.

floor(x) Returns the floor of x, that is, x rounded down to an integer.

ceil(x) Returns the ceiling of x, that is, x rounded up to an integer.

frac(x) Returns the fractional part of x, that is, the part behind the decimal dot.

sqrt(x) Returns the square root of x. x must be non-negative.

sqr(x) Returns x^2 .

power(x,n) Returns x to the power n.

exp(x) Returns e to the power x.

ln(x) Returns the natural logarithm of x.

log2(x) Returns the log base 2 of x.

log10(x) Returns the log base 10 of x.

logn(n,x) Returns the log base n of x.

sin(x) Returns the sine of x (x in radians).

cos(x) Returns the cosine of x (x in radians).

tan(x) Returns the tangent of x (x in radians).

arcsin(x) Returns the inverse sine of x.

arccos(x) Returns the inverse cosine of x.

arctan(x) Returns the inverse tangent of x.

arctan2(y,x) Calculates $\arctan(Y/X)$, and returns an angle in the correct quadrant.

degtorad(x) Converts degrees to radians.

radtodeg(x) Converts radians to degrees.

min(val1,val2,val3,...) Returns the minimum of the values. The function can have up to 16 arguments. They must either be all real or all strings.

max(val1,val2,val3,...) Returns the maximum of the values. The function can have up to 16 arguments. They must either be all real or all strings.

mean(val1,val2,val3,...) Returns the average of the values. The function can have up to 16 arguments. They must all be real values.

median(val1,val2,val3,...) Returns the median of the values, that is, the middle value. (When the number of arguments is even, the smaller of the two middle values is returned.) The function can have up to 16 arguments. They must all be real values.

point_distance(x1,y1,x2,y2) Returns the distance between point (x1,y1) and point (x2,y2).

point_distance_3d(x1,y1,z1,x2,y2,z2) Returns the distance between point (x1,y1,z1) and point (x2,y2,z2).

point_direction(x1,y1,x2,y2) Returns the direction from point (x1,y1) toward point (x2,y2) in degrees.

lengthdir_x(len,dir) Returns the horizontal x-component of the vector determined by the indicated length

and direction.

lengthdir_y(len, dir) Returns the vertical y-component of the vector determined by the indicated length and direction.

dot_product(x1, y1, x2, y2) normalizes the vectors (x1,y1) and (x2,y2) to unit vectors, and returns the dot product of these normalized vectors."

dot_product_3d(x1, y1, z1, x2, y2, z2) normalizes the vectors (x1,y1,z1) and (x2,y2,z2) to unit vectors, and returns the dot product of these normalized vectors."

is_real(x) Returns whether x is a real value (as opposed to a string).

is_string(x) Returns whether x is a string (as opposed to a real value).

String handling functions

The following functions deal with characters and string.

chr(val) Returns a string containing the character with code val for printing/displaying based on the current drawing font's character set codepage.

If no font is set, it will use default code page for the machine.

NOTE: This will change from machine to machine. If you need a specific codepage, then be sure to SET a font yourself at the start of your game..

If the font is a sprite font, no translation will be done.

ansi_char(val) Returns a string containing the character with raw BYTE value set.

NOTE: This will not, and should not be display, but it will save correctly to disk for use in encoding.

ord(str) Returns the ascii code of the first character in str.

real(str) Turns str into a real number. str can contain a minus sign, a decimal dot and even an exponential part.

string(val) Turns the real value into a string using a standard format (no decimal places when it is an integer, and two decimal places otherwise).

string_format(val,tot,dec) Turns val into a string using your own format: tot indicates the total number of places and dec indicates the number of decimal places.

string_length(str) Returns the number of characters in the string.

string_byte_length(str) Returns the number of BYTES in the string. As strings are now held as UTF8, this means the length of the string is no longer it's BYTE size.

string_pos(substr,str) Returns the position of substr in str (0=no occurrence).

string_copy(str,index,count) Returns a substring of str, starting at position index, and of length count.

string_char_at(str,index) Returns the character in str at position index.

string_byte_at(str,index) Returns the raw byte value as a REAL at BYTE position index.

string_delete(str,index,count) Returns a copy of str with the part removed that starts at position index and has length count.

string_insert(substr,str,index) Returns a copy of str with substr added at position index.

string_replace(str,substr,newstr) Returns a copy of str with the first occurrence of substr replaced by newstr.

string_replace_all(str,substr,newstr) Returns a copy of str with all occurrences of substr replaced by newstr.

string_count(substr,str) Returns the number of occurrences of substr in str.

string_lower(str) Returns a lowercase copy of str.

string_upper(str) Returns an uppercase copy of str.

string_repeat(str,count) Returns a string consisting of count copies of str.

string_letters(str) Returns a string that only contains the letters in str.

string_digits(str) Returns a string that only contains the digits in str.

string_lettersdigits(str) Returns a string that contains the letters and digits in str.

The following functions deal with the clipboard for storing text.

clipboard_has_text() Returns whether there is any text on the clipboard.

clipboard_get_text() Returns the current text on the clipboard.

clipboard_set_text(str) Sets the string str on the clipboard.

Dealing with dates and time

In *GameMaker* there are a number of functions to deal with dates and time. A date-time combination is stored in a real number. The integral part of a date-time value is the number of days that have passed since 12/30/1899. The fractional part of the date-time value is fraction of a 24 hour day that has elapsed. The following functions exist:

date_current_datetime() Returns the date-time value that corresponds to the current moment.

date_current_date() Returns the date-time value that corresponds to the current date only (ignoring the time).

date_current_time() Returns the date-time value that corresponds to the current time only (ignoring the date).

date_create_datetime(year,month,day,hour,minute,second) Creates a date-time value corresponding to the indicated date and time.

date_create_date(year,month,day) Creates a date-time value corresponding to the indicated date.

date_create_time(hour,minute,second) Creates a date-time value corresponding to the indicated time.

date_valid_datetime(year,month,day,hour,minute,second) Returns whether the indicated date and time are valid.

date_valid_date(year,month,day) Returns whether the indicated date is valid.

date_valid_time(hour,minute,second) Returns whether the indicated time is valid.

date_inc_year(date,amount) Returns a new date that is amount years after the indicated date. amount must be an integer number.

date_inc_month(date,amount) Returns a new date that is amount months after the indicated date. amount must be an integer number.

date_inc_week(date,amount) Returns a new date that is amount weeks after the indicated date. amount must be an integer number.

date_inc_day(date,amount) Returns a new date that is amount days after the indicated date. amount must be an integer number.

date_inc_hour(date,amount) Returns a new date that is amount hours after the indicated date. amount must be an integer number.

date_inc_minute(date,amount) Returns a new date that is amount minutes after the indicated date. amount must be an integer number.

date_inc_second(date,amount) Returns a new date that is amount seconds after the indicated date. amount must be an integer number.

date_get_year(date) Returns the year corresponding to the date.

date_get_month(date) Returns the month corresponding to the date.

date_get_week(date) Returns the week of the year corresponding to the date.

date_get_day(date) Returns the day of the month corresponding to the date.

date_get_hour(date) Returns the hour corresponding to the date.

date_get_minute(date) Returns the minute corresponding to the date.

date_get_second(date) Returns the second corresponding to the date.

date_get_weekday(date) Returns the day of the week corresponding to the date.

date_get_day_of_year(date) Returns the day of the year corresponding to the date.

date_get_hour_of_year(date) Returns the hour of the year corresponding to the date.

date_get_minute_of_year(date) Returns the minute of the year corresponding to the date.

date_get_second_of_year(date) Returns the second of the year corresponding to the date.

date_year_span(date1,date2) Returns the number of years between the two dates. It reports incomplete years as a fraction.

date_month_span(date1,date2) Returns the number of months between the two dates. It reports incomplete months as a fraction.

date_week_span(date1,date2) Returns the number of weeks between the two dates. It reports incomplete weeks as a fraction.

date_day_span(date1,date2) Returns the number of days between the two dates. It reports incomplete days as a fraction.

date_hour_span(date1,date2) Returns the number of hours between the two dates. It reports incomplete

hours as a fraction.

date_minute_span(date1,date2) Returns the number of minutes between the two dates. It reports incomplete minutes as a fraction.

date_second_span(date1,date2) Returns the number of seconds between the two dates. It reports incomplete seconds as a fraction.

date_compare_datetime(date1,date2) Compares the two date-time values. Returns -1, 0, or 1 depending on whether the first is smaller, equal, or larger than the second value.

date_compare_date(date1,date2) Compares the two date-time values only taking the date part into account. Returns -1, 0, or 1 depending on whether the first is smaller, equal, or larger than the second value.

date_compare_time(date1,date2) Compares the two date-time values only taking the time part into account. Returns -1, 0, or 1 depending on whether the first is smaller, equal, or larger than the second value.

date_date_of(date) Returns the date part of the indicated date-time value, setting the time part to 0.

date_time_of(date) Returns the time part of the indicated date-time value, setting the date part to 0.

date_datetime_string(date) Returns a string indicating the given date and time in the default format for the system.

date_date_string(date) Returns a string indicating the given date in the default format for the system.

date_time_string(date) Returns a string indicating the given time in the default format for the system.

date_days_in_month(date) Returns the number of days in the month indicated by the date-time value.

date_days_in_year(date) Returns the number of days in the year indicated by the date-time value.

date_leap_year(date) Returns whether the year indicated by the date-time value is a leap year.

date_is_today(date) Returns whether the indicated date-time value is on today.

Game play

There are a large number of variables and functions that you can use to define the game play. These in particular influence the movement and creation of instances, the timing, the room, and the handling of events.

Information on game play can be found in the following pages:

[Moving Around](#)

[Paths](#)

[Motion Planning](#)

[Collision Detection](#)

[Instances](#)

[Deactivating Instances](#)

[Timing](#)

[Rooms](#)

[Score](#)

[Generating Events](#)

[Miscellaneous Variables and Functions](#)

Moving around

Obviously, an important aspect of games is the moving around of object instances. Each instance has two built-in variables `x` and `y` that indicate the position of the instance. (To be precise, they indicate the place where the origin of the sprite is placed. Position (0,0) is the top-left corner of the room. You can change the position of the instance by changing its `x` and `y` variables. If you want the object to make complicated motions this is the way to go. You typically put this code in the step event for the object.

If the object moves with constant speed and direction, there is an easier way to do this. Each object instance has a horizontal speed (`hspeed`) and a vertical speed (`vspeed`). Both are indicated in pixels per step. A positive horizontal speed means a motion to the right, a negative horizontal speed mean a motion to the left. Positive vertical speed is downwards and negative vertical speed is upwards. So you have to set these variables only once (for example in the creating event) to give the object instance a constant motion.

There is quite a different way for specifying motion, using a direction (in degrees 0-359), and a speed (should be non-negative). You can set and read these variables to specify an arbitrary motion. (Internally this is changed into values for `hspeed` and `vspeed`.) Also there is the friction and the gravity and gravity direction. Finally, there is the function `motion_add(dir, speed)` to add a motion to the current one.

To be complete, each instance has the following variables and functions dealing with its position and motion:

- x** Its x-position.
- y** Its y-position.
- xprevious** Its previous x-position.
- yprevious** Its previous y-position.
- xstart** Its starting x-position in the room.
- ystart** Its starting y-position in the room.
- hspeed** Horizontal component of the speed.
- vspeed** Vertical component of the speed.
- direction** Its current direction (0-360, counter-clockwise, 0 = to the right).
- speed** Its current speed (pixels per step).
- friction** Current friction (pixels per step).
- gravity** Current amount of gravity (pixels per step).
- gravity_direction** Direction of gravity (270 is downwards).
- motion_set(dir, speed)** Sets the motion with the given speed in direction `dir`.
- motion_add(dir, speed)** Adds the motion to the current motion (as a vector addition).

There are a large number of functions available that help you in defining your motions:

- place_free(x, y)** Returns whether the instance placed at position (x,y) is collision-free. This is typically used as a check before actually moving to the new position.
- place_empty(x, y)** Returns whether the instance placed at position (x,y) meets nobody. So this function takes also non-solid instances into account.
- place_meeting(x, y, obj)** Returns whether the instance placed at position (x,y) meets `obj`. `obj` can be an object in which case the function returns true is some instance of that object is met. It can also be an instance id, the special word `all` meaning an instance of any object, or the special word `other`.
- place_snapped(hsnap, vsnap)** Returns whether the instance is aligned with the snapping values.
- move_random(hsnap, vsnap)** Moves the instance to a free random, snapped position, like the corresponding action.
- move_snap(hsnap, vsnap)** Snaps the instance, like the corresponding action.
- move_wrap(hor, vert, margin)** Wraps the instance when it has left the room to the other side. `hor` indicates whether to wrap horizontally and `vert` indicates whether to wrap vertically. `margin` indicates how far the origin of the instance must be outside the room before the wrap happens. So it is a margin around the room. You typically use this function in the Outside event.
- move_towards_point(x, y, sp)** Moves the instances with speed `sp` toward position (x,y).
- move_bounce_solid(adv)** Bounces against solid instances, like the corresponding action. `adv` indicates

whether to use advance bounce, that also takes slanted walls into account.

move_bounce_all(adv) Bounces against all instances, instead of just the solid ones.

move_contact_solid(dir,maxdist) Moves the instance in the direction until a contact position with a solid object is reached. If there is no collision at the current position, the instance is placed just before a collision occurs. If there already is a collision the instance is not moved. You can specify the maximal distance to move (use a negative number for an arbitrary distance).

move_contact_all(dir,maxdist) Same as the previous function but this time you stop at a contact with any object, not just solid objects.

move_outside_solid(dir,maxdist) Moves the instance in the direction until it no longer lies within a solid object. If there is no collision at the current position the instance is not moved. You can specify the maximal distance to move (use a negative number for an arbitrary distance).

move_outside_all(dir,maxdist) Same as the previous function but this time you move until outside any object, not just solid objects.

distance_to_point(x,y) Returns the distance of the bounding box of the current instance to (x,y). (If the instance does not have a sprite or mask, the result of the function is undefined.)

distance_to_object(obj) Returns the distance of the instance to the nearest instance of object obj. (If the instance or object does not have a sprite or mask, the result of the function is undefined.)

position_empty(x,y) Returns whether there is nothing at position (x,y).

position_meeting(x,y,obj) Returns whether at position (x,y) there is an instance obj. obj can be an object, an instance id, or the keywords `self`, `other`, or `all`.

Paths

In *GameMaker* you can define paths and order instances to follow such paths. Although you can use actions for this, there are functions and variables that give you more flexibility:

path_start(path, speed, endaction, absolute) Starts a path for the current instance. The `path` is the name of the path you want to start. The `speed` is the speed with which the path must be followed. A negative speed means that the instance moves backwards along the path. The `endaction` indicates what should happen when the end of the path is reached. The following values can be used:

- 0 : stop the path
- 1: continue from the start position (if the path is not closed we jump to the start position)
- 2: continue from the current position
- 3: reverse the path, that is change the sign of the speed

The argument `absolute` should be true or false. When true the absolute coordinates of the path are used. When false the path is relative to the current position of the instance. To be more precise, if the speed is positive, the start point of the path will be placed on the current position and the path is followed from there. When the speed is negative the end point of the path will be placed on the current position and the path is followed backwards from there.

path_end() Ends the following of a path for the current instance.

path_index* Index of the current path the instance follows. You cannot change this directly but must use the function above.

path_position Position in the current path. 0 is the beginning of the path. 1 is the end of the path. The value must lie between 0 and 1.

path_positionprevious Previous position in the current path. This can be used e.g. in collision events to set the position on the path back to the previous position.

path_speed Speed (in pixels per step) with which the path must be followed. Use a negative speed to move backwards.

path_orientation Orientation (counter-clockwise) into which the path is performed. 0 is the normal orientation of the path.

path_scale Scale of the path. Increase to make the path larger. 1 is the default value.

path_endaction The action that must be performed at the end of the path. You can use the values indicated above.

Motion planning

Motion planning helps you to move certain instances from a given location to a different location while avoiding collisions with certain other instances (e.g. walls). Motion planning is a difficult problem. It is impossible to give general functions that will work properly in all situations. Also, computing collision free motions is a time-consuming operation. So you have to be careful how and when you apply it. Please keep these remarks in mind when you use any of the following functions.

Different forms of motion planning are provided by *GameMaker*. The simplest form lets an instance take a step towards a particular goal position, trying to go straight if possible but taking a different direction if required. These functions should be used in the step event of an instance. They correspond to the motion planning actions that are also available:

`mp_linear_step(x,y,stepsize,checkall)` This function lets the instance take a step straight towards the indicated position (x,y). The size of the step is indicated by the `stepsize`. If the instance is already at the position it will not move any further. If `checkall` is true the instance will stop when it hits an instance of any object. If it is false it only stops when hitting a solid instance. Note that this function does not try to make detours if it meets an obstacle. It simply fails in that case. The function returns whether or not the goal position was reached.

`mp_linear_step_object(x,y,stepsize,obj)` Same as the function above but this time only instances of `obj` are considered as obstacles. `obj` can be an object or an instance id.

`mp_potential_step(x,y,stepsize,checkall)` Like the previous function, this function lets the instance take a step towards a particular position. But in this case it tries to avoid obstacles. When the instance would run into a solid instance (or any instance when `checkall` is true) it will change the direction of motion to try to avoid the instance and move around it. The approach is not guaranteed to work but in most easy cases it will effectively move the instance towards the goal. The function returns whether or not the goal was reached.

`mp_potential_step_object(x,y,stepsize,obj)` Same as the function above but this time only instances of `obj` are considered as obstacles. `obj` can be an object or an instance id.

`mp_potential_settings(maxrot,rotstep,ahead,onspot)` The previous function does its work using a number of parameters that can be changed using this function. Globally the method works as follows. It first tries to move straight towards the goal. It looks a number of steps ahead which can be set with the parameter `ahead` (default 3). Reducing this value means that the instance will start changing direction later. Increasing it means it will start changing direction earlier. If this check leads to a collision it starts looking at directions more to the left and to the right of the best direction. It does this in steps of size `rotstep` (default 10). Reducing this gives the instance more movement possibilities but will be slower. The parameter `maxrot` is a bit more difficult to explain. The instance has a current direction. `maxrot` (default 30) indicates how much it is allowed to change its current direction in a step. So even if it can move e.g. straight to the goal it will only do so if it does not violate this maximal change of direction. If you make `maxrot` large the instance can change a lot in each step. This will make it easier to find a short path but the path will be uglier. If you make the value smaller the path will be smoother but it might take longer detours (and sometimes even fail to find the goal). When no step can be made the behavior depends on the value of the parameter `onspot`. If `onspot` is true (the default value), the instance will rotate on its spot by the amount indicated with `maxrot`. If it is false it will not move at all. Setting it to false is useful for e.g. cars but reduces the chance of finding a path.

Please note that the potential approach uses only local information. So it will only find a path if this local information is enough to determine the right direction of motion. For example, it will fail to find a path out of a maze (most of the time).

The second kind of functions computes a collision-free path for the instance. Once this path has been computed you can assign it to the instance to move towards the goal. The computation of the path will take some time but after that the execution of the path will be fast. Of course this is only valid if the situation has not changed in the meantime. For example, if obstacles change you possibly will need to recompute the path. Again notice that these functions might fail. ***These functions are only available in the Standard Edition of GameMaker.***

The first two functions use the linear motion and potential field approach that were also used for the step functions.

`mp_linear_path(path,xg,yg,stepsize,checkall)` This function computes a straight-line path for the instance from its current position to the position (xg,yg) using the indicated step size. It uses steps as in the function `mp_linear_step()`. The indicated path must already exist and will be overwritten by the new path.

(See a later chapter on how to create and destroy paths.) The function will return whether a path was found. The function will stop and report failure if no straight path exists between start and goal. If it fails a path is still created that runs till the position where the instance was blocked.

mp_linear_path_object(path,xg,yg,stepsize,obj) Same as the function above but this time only instances of `obj` are considered as obstacles. `obj` can be an object or an instance id.

mp_potential_path(path,xg,yg,stepsize,factor,checkall) This function computes a path for the instance from its current position and orientation to the position (xg,yg) using the indicated step size trying to avoid collision with obstacles. It uses potential field steps, like in the function `mp_potential_step()` and also the parameters that can be set with `mp_potential_settings()`. The indicated path must already exist and will be overwritten by the new path. (See a later chapter on how to create and destroy paths.) The function will return whether a path was found. To avoid the function continuing to compute forever you need to provide a length factor larger than 1. The function will stop and report failure if it cannot find a path shorter than this factor times the distance between start and goal. A factor of 4 is normally good enough but if you expect long detours you might make it longer. If it fails a path is still created that runs in the direction of the goal but it will not reach it.

mp_potential_path_object(path,xg,yg,stepsize,factor,obj) Same as the function above but this time only instances of `obj` are considered as obstacles. `obj` can be an object or an instance id.

The other functions use a much more complex mechanism using a grid-based approach (sometimes called an A* algorithm). It will be more successful in finding paths (although it still might fail) and will find shorter paths but it required more work on your side. The global idea is as follows. First of all we put a grid on (the relevant part of) the room. You can choose to use a fine grid (which will be slower) or a coarse grid. Next, for all relevant objects we determine the grid cells they overlap (either using bounding boxes or precise checking) and mark these cells as being forbidden. So a cell will be marked totally forbidden, even if it only partially overlaps with an obstacle. Finally we specify a start and a goal position (which must lie in free cells) and the function computes the shortest path (actually close to the shortest) between these. The path will run between centers of free cells. So if the cells are large enough so that the instance placed at its center will lie completely inside it this will be successful. This path you can now give to an instance to follow.

The grid-based approach is very powerful (and is used in many professional games) but it requires that you do some careful thinking. You must determine which area and cell size are good enough for solving the game. Also you must determine which objects must be avoided and whether precise checking is important. All these parameters strongly influence the efficiency of the approach.

In particular the size of the cells is crucial. Remember that the cells must be large enough so that the moving object placed with its origin on the center of a cell must lie completely inside the cell. (Be careful about the position of the origin of the object. Also realize that you can shift the path if the origin of the object is not in its center!) On the other hand, the smaller the cells the more possible paths exist. If you make cells too large, openings between obstacles may get closed because all cells intersect an obstacle.

The actual functions for the grid-based approach are as follows:

mp_grid_create(left,top,hcells,vcells,cellwidth,cellheight) This function creates the grid. It returns an index that must be used in all other calls. You can create and maintain multiple grid structures at the same moment. `left` and `top` indicate the position of the top-left corner of the grid. `hcells` and `vcells` indicate the number of horizontal and vertical cells. Finally `cellwidth` and `cellheight` indicate the size of the cells.

mp_grid_destroy(id) Destroys the indicated grid structure and frees its memory. Don't forget to call this if you don't need the structure anymore.

mp_grid_clear_all(id) Mark all cells in the grid to be free.

mp_grid_clear_cell(id,h,v) Clears the indicated cell. Cell 0,0 is the top left cell.

mp_grid_clear_rectangle(id,left,top,right,bottom) Clears all cells that intersect the indicated rectangle (in room coordinates).

mp_grid_add_cell(id,h,v) Marks the indicated cell as being forbidden. Cell 0,0 is the top left cell.

mp_grid_add_rectangle(id,left,top,right,bottom) Marks all cells that intersect the indicated rectangle as being forbidden.

mp_grid_add_instances(id,obj,prec) Marks all cells that intersect an instance of the indicated object as being forbidden. You can also use an individual instance by making `obj` the id of the instance. Also you can use the keyword `all` to indicate all instances of all objects. `prec` indicates whether precise collision checking must

be used (will only work if precise checking is enabled for the sprite used by the instance).

mp_grid_path(id,path,xstart,ystart,xgoal,ygoal,allowdiag) Computes a path through the grid. path must indicate an existing path that will be replaced by the computer path. xstart and ystart indicate the start of the path and xgoal and ygoal the goal. allowdiag indicates whether diagonal moves are allowed instead of just horizontal or vertical. The function returns whether it succeeded in finding a path. (Note that the path is independent of the current instance; It is a path through the grid, not a path for a specific instance.)

mp_grid_draw(id) This function draws the grid with green cells being free and red cells being forbidden. This function is slow and only provided as a debug tool.

Collision checking

When planning motions or deciding on certain actions, it is often important to see whether there are collisions with other objects at certain places. The following routines can be used for this. All these have three arguments in common: The argument `obj` can be an object, the keyword `all`, or the id of an instance. The argument `prec` indicates whether the check should be precise or only based on the bounding box of the instance. Precise checking is only done when the sprite for the instance has the precise collision checking set. The argument `notme` can be set to true to indicate that the calling instance should not be checked. All these functions return either the id of one of the instances that collide, or they return a negative value when there is no collision.

`collision_point(x,y,obj,prec,notme)` This function tests whether at point (x,y) there is a collision with entities of object `obj`.

`collision_rectangle(x1,y1,x2,y2,obj,prec,notme)` This function tests whether there is a collision between the (filled) rectangle with the indicated opposite corners and entities of object `obj`. For example, you can use this to test whether an area is free of obstacles.

`collision_circle(xc,yc,radius,obj,prec,notme)` This function tests whether there is a collision between the (filled) circle centered at position (xc,yc) with the given radius and entities of object `obj`. For example, you can use this to test whether there is an object close to a particular location.

`collision_ellipse(x1,y1,x2,y2,obj,prec,notme)` This function tests whether there is a collision between the (filled) ellipse with the indicated opposite corners and entities of object `obj`.

`collision_line(x1,y1,x2,y2,obj,prec,notme)` This function tests whether there is a collision between the line segment from (x1,y1) to (x2,y2) and entities of object `obj`. This is a powerful function. You can e.g. use it to test whether an instance can see another instance by checking whether the line segment between them intersects a wall.

Instances

In the game, the basic units are the instances of the different objects. During game play you can change a number of aspects of these instances. Also you can create new instances and destroy instances. Besides the movement related variables discussed above and the drawing related variables discussed below, each instance has the following variables:

object_index* Index of the object this is an instance of. This variable cannot be changed.

id* The unique identifier for the instance (≥ 100000). (Note that when defining rooms the id of the instance under the mouse is always indicated.)

mask_index Index of the sprite used as mask for collisions. Give this a value of -1 to make it the same as the `sprite_index`.

solid Whether the instance is solid. This can be changed during the game.

persistent Whether the instance is persistent and will reappear when moving to another room. You often want to switch persistence off at certain moments. (For example if you go back to the first room.)

There is one problem when dealing with instances. It is not so easy to identify individual instances. They don't have a name. When there is only one instance of a particular object you can use the object name but otherwise you need to get the id of the instance. This is a unique identifier for the instance. you can use it in **with** statements and as object identifier. Fortunately there are a number of variables and routines that help you locate instance id's.

instance_count* Number of instances that currently exist in the room.

instance_id[0..n-1]* The id of the particular instance. Here n is the number of instance.

Note that the assignment of the instances to the instance id's changes every step so you cannot use values from previous steps. Also please note that instances that are deleted will remain in the list until the end of the step. So if you are also deleting instances you need to check whether the instance still exists. Let me give an example. Assume each unit in your game has a particular power and you want to locate the strongest one, you could use the following code:

```
{
  maxid = -1;
  maxpower = 0;
  for (i=0; i<instance_count; i+=1)
  {
    iii = instance_id[i];
    if (instance_exists(iii))
      if (iii.object_index == unit)
      {
        if (iii.power > maxpower)
          {maxid = iii; maxpower = iii.power;}
      }
  }
}
```

After the loop `maxid` will contain the id of the unit with largest power. Of course, for this particular situation the following code would be better:

```
{
  maxid = -1;
  maxpower = 0;
  with (unit) do
  {
    if (power > maxpower)
      {maxid = self; maxpower = power;}
  }
}
```

instance_find(obj,n) Returns the id of the (n+1)'th instance of type obj. obj can be an object or the keyword all. If it does not exist, the special object noone is returned. Note that the assignment of the instances to the instance id's changes every step so you cannot use values from previous steps.

instance_exists(obj) Returns whether an instance of type obj exists. obj can be an object, an instance id, or the keyword all.

instance_number(obj) Returns the number of instances of type obj. obj can be an object or the keyword all.

instance_position(x,y,obj) Returns the id of the instance of type obj at position (x,y). When multiple instances are at that position the first is returned. obj can be an object or the keyword all. If it does not exist, the special object noone is returned.

instance_nearest(x,y,obj) Returns the id of the instance of type obj nearest to (x,y). obj can be an object or the keyword all.

instance_furthest(x,y,obj) Returns the id of the instance of type obj furthest away from (x,y). obj can be an object or the keyword all.

instance_place(x,y,obj) Returns the id of the instance of type obj met when the current instance is placed at position (x,y). obj can be an object or the keyword all. If it does not exist, the special object noone is returned.

The following functions can be used for creating and destroying instances.

instance_create(x,y,obj) Creates an instance of obj at position (x,y). The function returns the id of the new instance.

instance_copy(performevent) Creates a copy of the current instance. The argument indicates whether the creation event must be executed for the copy. The function returns the id of the new copy.

instance_destroy() Destroys the current instance.

instance_change(obj,perf) Changes the instance into obj. perf indicates whether to perform the destroy and creation events.

position_destroy(x,y) Destroys all instances whose sprite contains position (x,y).

position_change(x,y,obj,perf) Changes all instances at (x,y) into obj. perf indicates whether to perform the destroy and creation events.

Deactivating Instances

Please be aware that deactivating and activating instances can sometimes lead to unexpected problems. So you are strongly advised not to use this feature except for very simple situation like the ones described below. The feature is mainly left in for backward compatibility.

When you create large room, for example in platform games, with a small view, many instances lie outside the view. Such instances though are still active and will execute their events. Also when performing collision checks these instances are taken into account. This can cost a lot of time, which is often not necessary. (For example, often it is not important whether instances outside the view move.) To solve this problem *GameMaker* contains some functions to deactivate and activate instances. Before using them you must though clearly understand how they work.

When you deactivate instances they are in some sense removed from the game. They are not visible anymore nor are any events executed for them. So for all actions and functions they don't exist anymore. This saves a lot of time but you have to be careful. For example, when you delete all instances of a particular type, deactivated instances are not deleted (because they don't exist). So don't think that a key a player picks up can unlock a deactivated door. Also persistent deactivated instances are **not** moved over to the next room (even though they are persistent). Also make sure that after you deactivate an instance that you no longer execute code for it. This can in particular happen when an instance deactivates itself. In general you better never have an instance deactivate itself.

The most crucial mistake you can make is to deactivate the instance that is responsible for the activation. To avoid this some of the routines below allow you to insist that the calling instance should not be deactivated itself.

Here are the available routines:

`instance_deactivate_all(notme)` Deactivates all instances in the room. If `notme` is true the calling instance is not deactivated (which is normally what you want).

`instance_deactivate_object(obj)` Deactivates all instances in the room of the given object. You can also use `all` to indicate that all instances must be deactivated or the id of an instance to deactivate an individual instance.

`instance_deactivate_region(left,top,width,height,inside,notme)` Deactivates all instances in the indicated region (that is, those whose bounding box lies partially inside the region). If `inside` is false the instances completely outside the region are deactivated. If `notme` is true the calling instance is not deactivated (which is normally what you want).

`instance_activate_all()` Activates all instances in the room.

`instance_activate_object(obj)` Activates all instances in the room of the given object. You can also use `all` to indicate that all instances must be activated or the id of an instance to activate an individual instance.

`instance_activate_region(left,top,width,height,inside)` Activates all instances in the indicated region. If `inside` is false the instances completely outside the region are activated.

For example, to deactivate all instances outside the view and activate the ones inside the view, you could place the following code in the step event of the moving character:

```
{
    instance_activate_all();
    instance_deactivate_region(view_xview[0],view_yview[0],
                             view_wview[0],view_hview[0],false,true);
}
```

In practice you might want to use a region slightly larger than the view.

Timing

Good games require careful timing of things happening. Fortunately *GameMaker* does most of the timing for you. It makes sure things happen at a constant rate. This rate is defined when defining the rooms. But you can change it using the global variable `room_speed`. So for example, you can slowly increase the speed of the game, making it more difficult, by adding a very small amount (like 0.001) to `room_speed` in every step. If your machine is slow the game speed might not be achieved. This can be checked using the variable `fps` that constantly monitors the actual number of frames per second. Finally, for some advanced timing you can use the variable `current_time` that gives the number of milliseconds since the computer was started. Here is the total collection of variables available (only the first one can be changed):

room_speed Speed of the game in the current room (in steps per second).
fps* Number of frames that are actually drawn per second.
current_time* Number of milliseconds that have passed since the system was started.
current_year* The current year.
current_month* The current month.
current_day* The current day.
current_weekday* The current day of the week (1=sunday, ..., 7=saturday).
current_hour* The current hour.
current_minute* The current minute.
current_second* The current second.

Sometimes you might want to stop the game for a short while. For this, use the sleep function.

sleep (numb) Sleeps numb milliseconds.

As you should know, every instance has 12 different alarm clocks that you can set. To change the values (or get the values) of the different alarm clocks use the following variable:

alarm[0..11] Value of the indicated alarm clock. (Note that alarm clocks only get updated when the alarm event for the object contains actions!)

We have seen that for complex timing issues you can use the time line resource. Each instance can have a time line resource associated with it. The following variables deal with this:

timeline_index Index of the time line associated with the instance. You can set this to a particular time line to use that one. Set it to -1 to stop using a time line for the instance. Note that this does not start the time line. For this use the variable `timeline_running`.
timeline_position Current position within the time line. You can change this to skip certain parts or to repeat parts.
timeline_speed Normally, in each step the position in the time line is increased by 1. You can change this amount by setting this variable to a different value. You can use real numbers like 0.5. If the value is larger than one, several moments can happen within the same time step. They will all be performed in the correct order, so no actions will be skipped. You can also use a negative value to let the time line play backwards.
timeline_running Indicates whether the time line is running (true) or paused or stopped (false). You can change this variable to run or stop the time line.
timeline_looping Indicated whether the time line is looping (true) or not (false). You can change this variable to switch looping on or off.

Rooms

Games work in rooms. Each room has an index that is indicated by the name of the room. The current room is stored in variable `room`. You cannot assume that rooms are numbered in a consecutive order. So never add or subtract a number from the room variable. Instead use the functions and variables indicated below. So a typical piece of code you will use is:

```
{  
    if (room != room_last)  
    {  
        room_goto_next();  
    }  
    else  
    {  
        game_end();  
    }  
}
```

The following variables and functions exist that deal with rooms.

room Index of the current room; can be changed to go to a different room, but you had better use the routines below.

room_first* Index of the first room in the game.

room_last* Index of the last room in the game.

room_goto(numb) Goto the room with index numb.

room_goto_previous() Go to the previous room.

room_goto_next() Go to the next room.

room_restart() Restart the current room.

room_previous(numb) Return the index of the room before numb (-1 = none) but don't go there.

room_next(numb) Return the index of the room after numb (-1 = none).

game_end() End the game.

game_restart() Restart the game.

When calling one of the above functions to change the room or end or restart the game, please realize that this change does actually not occur at that precise moment. It only happens after the current action is fully executed. So the rest of the script will still be executed, and the same applies to possible calling scripts. However, no events are executed anymore. As this can lead to unexpected behavior you are strongly advised not to put any code anymore after the use of such functions.

Rooms have a number of additional properties:

room_width* Width of the room in pixels.

room_height* Height of the room in pixels.

room_caption Caption string for the room that is displayed in the caption of the window.

room_persistent Whether the current room is persistent.

Many games offer the player the possibility of saving the game and loading a saved game. In *GameMaker* this happens automatically when the player press <F5> for saving and <F6> for loading. You can also save and load games from within a piece of code (note that loading only takes place at the end of the current step).

game_save(string) Saves the game to the file with name string.

game_load(string) Loads the game from the file with name string.

Please realize that only the basic game data is being saved. If for example you play a particular piece of music, the precise position in the music is not saved. Also changed resources are not saved. Other things that are not saved are the contents of data structures, particles, and multiplayer settings.

Transitions

When you move from one room to another you can select a transition. To set the transition to the next frame you must set the variable called `transition_kind`. If you assign a value larger than 0 to it the corresponding transition is used for the next room transition. It only affect the next transition. After this the value is reset to 0, which indicates no transition.

`transition_kind` Indicates the next room transition. You can use the following builtin values

- 0 = no effect
- 1 = Create from left
- 2 = Create from right
- 3 = Create from top
- 4 = Create from bottom
- 5 = Create from center
- 6 = Shift from left
- 7 = Shift from right
- 8 = Shift from top
- 9 = Shift from bottom
- 10 = Interlaced from left
- 11 = Interlaced from right
- 12 = Interlaced from top
- 13 = Interlaced from bottom
- 14 = Push from left
- 15 = Push from right
- 16 = Push from top
- 17 = Push from bottom
- 18 = Rotate to the left
- 19 = Rotate to the right
- 20 = Blend the rooms
- 21 = Fade out and in

`transition_steps` Indicates the number of steps in the transition. The more steps, the longer the transition takes. Default is 80.

`transition_define(kind,name)` You can actually create your own transitions. To this end you must define a script (possibly in an extension package) to do the transition. With this function you can then add the transition to the system. `kind` is the index of the transition (either a new one or an existing transitions). `name` is the name of the script. Note that the name of the script is a string! So there must be quotes around it. Note that this is really advanced stuff. The script must take five arguments: a surface with the image of the previous room, a surface with the image of the next room, the width of the surfaces, the height of the surfaces, and the fraction of the transition (between 0 and 1). It must then draw the image using the two surfaces.

`transition_exists(kind)` This function returns whether a transition of the indicated kind exists.

Please note that transitions do not work when using 3d graphics. Also, room transitions in general do not work correctly when the sizes of the rooms (or to be more precise of the region on the screen) are not the same.

Score

Other important aspects of many games are the score, the health, and the number of lives. *GameMaker* keeps track of the `score` in a global variable `score` and the number of `lives` in a global variable `lives`. You can change the score by simply changing the value of this variable. The same applies to health and lives. If `lives` is larger than 0 and becomes smaller than or equal to 0 the no-more-lives event is performed for all instances. If you don't want to show the score and lives in the caption, set the variable `show_score`, etc., to false. Also you can change the caption. For more complicated games best display the score yourself.

score The current score.

lives Number of lives.

health The current health (0-100).

show_score Whether to show the score in the window caption.

show_lives Whether to show the number of lives in the window caption.

show_health Whether to show the health in the window caption.

caption_score The caption used for the score.

caption_lives The caption used for the number of lives.

caption_health The caption used for the health.

Generating events

As you know, *GameMaker* is completely event driven. All actions happen as the result of events. There are a number of different events. Creation and destroy events happen when an instance is created or destroyed. In each step, the system first handles the begin step events. Next it handles the alarm events, keyboard and mouse events and next the step event. After this the instances are set to their new positions after which the collision event is handled. Finally the end step events are handled after which the draw event is used to draw the instances (note that when there are multiple views the draw event is called multiple times in each step). You can also apply an event to the current instance from within a piece of code. The following functions exist:

event_perform(type, numb) Performs event numb of the indicated type to the current instance. The following event types can be indicated:

```
ev_create
ev_destroy
ev_step
ev_alarm
ev_keyboard
ev_mouse
ev_collision
ev_other
ev_draw
ev_keypress
ev_keyrelease
ev_trigger
```

When there are multiple events of the given type, numb can be used to specify the precise event. For the event type `ev_alarm` numb can range from 0 to 11. For the `ev_keyboard`, `ev_keypress`, and `ev_keyrelease` event types you have to use the keycode for the key. For `ev_mouse` events you can use for numb the following constants:

```
ev_left_button
ev_right_button
ev_middle_button
ev_no_button
ev_left_press
ev_right_press
ev_middle_press
ev_left_release
ev_right_release
ev_middle_release
ev_mouse_enter
ev_mouse_leave
ev_mouse_wheel_up
ev_mouse_wheel_down
ev_global_left_button
ev_global_right_button
ev_global_middle_button
ev_global_left_press
ev_global_right_press
ev_global_middle_press
ev_global_left_release
ev_global_right_release
ev_global_middle_release
ev_joystick1_left
ev_joystick1_right
```

```
ev_joystick1_up
ev_joystick1_down
ev_joystick1_button1
ev_joystick1_button2
ev_joystick1_button3
ev_joystick1_button4
ev_joystick1_button5
ev_joystick1_button6
ev_joystick1_button7
ev_joystick1_button8
ev_joystick2_left
ev_joystick2_right
ev_joystick2_up
ev_joystick2_down
ev_joystick2_button1
ev_joystick2_button2
ev_joystick2_button3
ev_joystick2_button4
ev_joystick2_button5
ev_joystick2_button6
ev_joystick2_button7
ev_joystick2_button8
```

For the collision event you give the index of the other object. For the event type `ev_other` you can use for number the following constants:

```
ev_outside
ev_boundary
ev_game_start
ev_game_end
ev_room_start
ev_room_end
ev_no_more_lives
ev_no_more_health
ev_animation_end
ev_end_of_path
ev_close_button
ev_user0
ev_user1
ev_user2
ev_user3
ev_user4
ev_user5
ev_user6
ev_user7
ev_user8
ev_user9
ev_user10
ev_user11
ev_user12
ev_user13
ev_user14
ev_user15
```

For the `ev_step` event type you can use the following constants for number:

```
ev_step_normal
ev_step_begin
```

ev_step_end

Finally for the `ev_trigger` event type you should use the constants that you can specify when defining these events.

event_perform_object(obj, type, numb) This functions works the same as the function above except that this time you can specify events in another object. Note that the actions in these events are applied to the current instance, not to instances of the given object!

event_user(numb) In the other events you can also define 16 user events. These are only performed if you call this function. numb must lie in the range 0 to 15.

event_inherited() Performs the inherited event. This only works if the instance has a parent object.

You can get information about the current event being executed using the following read-only variables:

event_type* Type of the current event begin executed.

event_number* Number of the current event begin executed.

event_object* The object index for which the current event is being executed.

event_action* The index of the action that is currently being executed (0 is the first in the event, etc.).

Miscellaneous Variables and Functions

Here are some variables and functions that deal with errors.

error_occurred Indicates whether an error has occurred.

error_last String indicating the last error message.

show_debug_message(str) Shows the string in debug mode.

debug_mode This read-only variable indicates whether the game is running in debug mode.

The following variables can be used to make sure your code will work for the appropriate version and edition of *GameMaker*.

gamemaker_pro Indicates whether the game is created with the Standard Edition.

gamemaker_registered Same as **gamemaker_pro**

gamemaker_version The version of *GameMaker*. This is an integer. For version 8.0 this can be anything between 800 and 809. For version 8.1 this will be something between 810 and 819, etc. So never check a particular version but better check for a range. This variable is not available in version before 800.

The following functions exist that allow you to check whether certain variables exist and with which you can set variables and get their values. In all these functions the variable name is passed as a string!

variable_global_exists(name) Returns whether a global variable with the given name (a string) exists.

variable_local_exists(name) Returns whether a local variable with the given name (a string) exists for the current instance.

variable_global_get(name) Returns the value of the global variable with the given name (a string).

variable_global_array_get(name,ind) Returns the value of index *ind* of the global array variable with the given name (a string).

variable_global_array2_get(name,ind1,ind2) Returns the value of index *ind1,ind2* of the global 2-dimensional array variable with the given name (a string).

variable_local_get(name) Returns the value of the local variable with the given name (a string).

variable_local_array_get(name,ind) Returns the value of index *ind* of the local array variable with the given name (a string).

variable_local_array2_get(name,ind1,ind2) Returns the value of index *ind1,ind2* of the local 2-dimensional array variable with the given name (a string).

variable_global_set(name,value) Sets the global variable with the given name (a string) to the given value.

variable_global_array_set(name,ind,value) Sets the index *ind* in the global array variable with the given name (a string) to the given value.

variable_global_array2_set(name,ind1,ind2,value) Sets the index *ind1,ind2* in the global 2-dimensional array variable with the given name (a string) to the given value.

variable_local_set(name,value) Sets the local variable with the given name (a string) to the given value.

variable_local_array_set(name,ind,value) Sets the index *ind* in the local array variable with the given name (a string) to the given value.

variable_local_array2_set(name,ind1,ind2,value) Sets the index *ind1,ind2* in the local 2-dimensional array variable with the given name (a string) to the given value.

For example, you can write:

```
{
    if variable_global_exists('ammunition')
        global.ammunition += 1
    else
        global.ammunition = 0
}
```

You can also use these functions to pass variables to a script in a sort of by-reference way, by passing their names as strings and using the functions to change them.

You can change the program priority using the following function:

set_program_priority(priority) Sets the priority for the program. You can indicate a value between -3 and +3. A value of -3 means that the program will only run if no other process on the computer requires processing time, or stated differently, when all other processes are idle. Values of -2 and -1 are below normal, so other processes will get priority. 0 is the normal value. +1 and +2 give a higher priority, resulting possibly in higher speed and smoother game flow. But other processes will get much less processing time. +3 indicates real-time mode. In real-time mode basically all time is allotted to the game. This can lead to serious problems with any other applications running on the computer. Also keyboard events and e.g. the pressing of the close box might no longer be recorded by Windows. So only use this if you want all the processor time. Also better check carefully before using it and save the game before running.

Finally, you can use the following function to set the title of the application:

set_application_title(title) Sets the title of the application to the given string. The title is for example shown in the task bar.

User interaction

There is no game without interaction with the user. The standard way of doing this in *GameMaker* is to put actions in mouse or keyboard events. But sometimes you need more control. From within a piece of code you can check whether certain keys on the keyboard are pressed and you can check for the position of the mouse and whether its buttons are pressed. Normally you check these aspects in the step event of some controller object and take action accordingly.

Information on user interaction can be found in the following pages:

[The Keyboard](#)

[The Mouse](#)

[The Joystick](#)

The Keyboard

For keyboard interaction, the following variables and functions exist:

keyboard_lastkey Keycode of last key pressed. See below for keycode constants. You can change it, e.g. set it to 0 if you handled it.

keyboard_key Keycode of current key pressed (see below; 0 if none).

keyboard_lastchar Last character pressed (as string).

keyboard_string String containing the last at most 1024 characters typed. This string will only contain the printable characters typed. It also correctly responds to pressing the backspace key by erasing the last character.

Sometimes it is useful to map one key to another. For example you might want to allow the player to use both the arrow keys and the numpad keys. Rather than duplicating the actions you can map the numpad keys to the arrow keys. Also you might want to implement a mechanism in which the player can set the keys to use. For this the following functions are available:

keyboard_set_map(key1, key2) Maps the key with keycode key1 to key2.

keyboard_get_map(key) Returns the current mapping for key.

keyboard_unset_map() Resets all keys to map to themselves.

To check whether a particular key or mouse button is pressed you can use the following functions. This is in particular useful when multiple keys are pressed simultaneously.

keyboard_check(key) Returns whether the key with the particular keycode is currently down.

keyboard_check_pressed(key) Returns whether the key with the particular keycode was pressed since the last step.

keyboard_check_released(key) Returns whether the key with the particular keycode was released since the last step.

keyboard_check_direct(key) Returns whether the key with the particular keycode is pressed by checking the hardware directly. The result is independent of which application has focus. It allows for a few more checks. In particular you can use keycodes `vk_lshift`, `vk_lcontrol`, `vk_lalt`, `vk_rshift`, `vk_rcontrol` and `vk_ralt` to check whether the left or right shift, control or alt key is pressed.

The following routines can be used to manipulate the keyboard state:

keyboard_get_numlock() Returns whether the numlock is set.

keyboard_set_numlock(on) Sets (true) or unsets (false) the numlock.

keyboard_key_press(key) Simulates a press of the key with the indicated keycode.

keyboard_key_release(key) Simulates a release of the key with the indicated keycode.

The following constants for virtual keycodes exist:

vk_nokey keycode representing that no key is pressed
vk_anykey keycode representing that any key is pressed
vk_left keycode for left arrow key
vk_right keycode for right arrow key
vk_up keycode for up arrow key
vk_down keycode for down arrow key
vk_enter enter key
vk_escape escape key
vk_space space key
vk_shift shift key
vk_control control key
vk_alt alt key
vk_backspace backspace key
vk_tab tab key
vk_home home key

vk_end end key
vk_delete delete key
vk_insert insert key
vk_pageup pageup key
vk_pagedown pagedown key
vk_pause pause/break key
vk_printscreen printscreen/sysrq key
vk_f1 ... **vk_f12** keycodes for the function keys F1 to F12
vk_numpad0 ... **vk_numpad9** number keys on the numeric keypad
vk_multiply multiply key on the numeric keypad
vk_divide divide key on the numeric keypad
vk_add add key on the numeric keypad
vk_subtract subtract key on the numeric keypad
vk_decimal decimal dot keys on the numeric keypad

For the letter keys use for example `ord('A')`. (The capital letters.) For the digit keys use for example `ord('5')` to get the <5> key. The following constants can only be used in `keyboard_check_direct`:

vk_lshift left shift key
vk_lcontrol left control key
vk_lalt left alt key
vk_rshift right shift key
vk_rcontrol right control key
vk_ralt right alt key

For example, assume you have an object that the user can control with the arrow keys you can put the following piece of code in the step event of the object:

```
{
    if (keyboard_check(vk_left)) x -= 4;
    if (keyboard_check(vk_right)) x += 4;
    if (keyboard_check(vk_up)) y -= 4;
    if (keyboard_check(vk_down)) y += 4;
}
```

Of course it is a lot easier to simply put this in the keyboard events.

There are some additional functions related to keyboard interaction.

keyboard_clear(key) Clears the state of the key. This means that it will no longer generate keyboard events until it starts repeating.
io_clear() Clears all keyboard and mouse states.
io_handle() Handle user io, updating keyboard and mouse status.
keyboard_wait() Waits till the user presses a key on the keyboard.

The Mouse

For mouse interaction, the following variables and functions exist:

mouse_x* X-coordinate of the mouse in the room. Cannot be changed.

mouse_y* Y-coordinate of the mouse in the room. Cannot be changed.

mouse_button Currently pressed mouse button. As value use `mb_none`, `mb_any`, `mb_left`, `mb_middle`, or `mb_right`.

mouse_lastbutton Last pressed mouse button.

To check whether a particular mouse button is pressed you can use the following functions. This is in particular useful when multiple keys are pressed simultaneously.

mouse_check_button(numb) Returns whether the mouse button is currently down (use as values `mb_none`, `mb_left`, `mb_middle`, or `mb_right`).

mouse_check_button_pressed(numb) Returns whether the mouse button was pressed since the last step.

mouse_check_button_released(numb) Returns whether the mouse button was released since the last step.

The following functions can be used to check whether the mouse wheel was used.

mouse_wheel_up() Returns whether the mouse wheel was moved up since the last step.

mouse_wheel_down() Returns whether the mouse wheel was moved down since the last step.

There are some additional functions related to mouse interaction.

mouse_clear(button) Clears the state of the mouse button. This means that it will no longer generate mouse events until the player releases it and presses it again.

io_clear() Clears all keyboard and mouse states.

io_handle() Handle user io, updating keyboard and mouse status.

mouse_wait() Waits till the user presses a mouse button

.

You can change the way the mouse cursor looks like. You can choose any sprite for this. To this end you can use the following variable:

cursor_sprite Indicates the sprite that is used to represent the cursor (default no sprite is used, represented by a value of -1). You can assign one of the sprites to this variable to have it been drawn automatically at the position of the mouse cursor. (You can also switch off the windows mouse cursor in the **Global Game Settings**.)

The Joystick

There are some events associated with joysticks. But to have full control over the joysticks there is a whole set of functions to deal with joysticks. *GameMaker* supports up to two joysticks. So all of these functions take a joystick id as argument.

joystick_exists(id) Returns whether joystick id (1 or 2) exists.

joystick_name(id) Returns the name of the joystick

joystick_axes(id) Returns the number of axes of the joystick.

joystick_buttons(id) Returns the number of buttons of the joystick.

joystick_has_pov(id) Returns whether the joystick has point-of-view capabilities.

joystick_direction(id) Returns the keycode (vk_numpad1 to vk_numpad9) corresponding to the direction of joystick id (1 or 2).

joystick_check_button(id,numb) Returns whether the joystick button is pressed (numb in the range 1-32).

joystick_xpos(id) Returns the position (-1 to 1) of the x-axis of joystick id.

joystick_ypos(id) Returns the joystick's y-position.

joystick_zpos(id) Returns the joystick's z-position (if it has a z-axis).

joystick_rpos(id) Returns the joystick's rudder position (or fourth axis).

joystick_upos(id) Returns the joystick's u-position (or fifth axis).

joystick_vpos(id) Returns the joystick's v-position (or sixth axis).

joystick_pov(id) Returns the joystick's point-of-view position. This is an angle between 0 and 360 degrees. 0 is forwards, 90 to the right, 180 backwards and 270 to the left. When no point-of-view direction is pressed by the user -1 is returned.

Grafica

An important part of a game is the graphics. *GameMaker* normally takes care of most of this and for simple games there is need to worry about it. But sometimes you want to take more control. For some aspects there are actions but from code you can control many more aspects. This chapter describes all variables and functions available for this and gives some more information about what is really happening.

Information on game graphics can be found in the following pages:

[Sprites and Images](#)

[Backgrounds](#)

[Drawing Sprites and Backgrounds](#)

[Drawing Shapes](#)

[Fonts and Text](#)

[Advanced Drawing Functions](#)

[Drawing Surfaces](#)

[Tiles](#)

[The Display](#)

[The Window](#)

[Views](#)

[Repainting the Screen](#)

Sprites and Images

Each object has a sprite associated with it. This is either a single image or it consists of multiple images. For each instance of the object the program draws the corresponding image on the screen, with its origin (as defined in the sprite properties) at the position (x,y) of the instance. When there are multiple images, it cycles through the images to get an animation effect. There are a number of variables that affect the way the image is drawn. These can be used to change the effects. Each instance has the following variables:

visible If visible is true (1) the image is drawn, otherwise it is not drawn. Invisible instances are still active and create collision events; only you don't see them. Setting the visibility to false is useful for e.g. controller objects (make them non-solid to avoid collision events) or hidden switches.

sprite_index This is the index of the current sprite for the instance. You can change it to give the instance a different sprite. As value you can use the names of the different sprites you defined. Changing the sprite does not change the index of the currently visible subimage.

sprite_width* Indicates the width of the sprite. This value cannot be changed but you might want to use it.

sprite_height* Indicates the height of the sprite. This value cannot be changed but you might want to use it.

sprite_xoffset* Indicates the horizontal offset of the sprite as defined in the sprite properties. This value cannot be changed but you might want to use it.

sprite_yoffset* Indicates the vertical offset of the sprite as defined in the sprite properties. This value cannot be changed but you might want to use it.

image_number* The number of subimages for the current sprite for the instance (cannot be changed).

image_index When the image has multiple subimages the program cycles through them. This variable indicates the currently drawn subimage (they are numbered starting from 0). You can change the current image by changing this variable. The program will continue cycling, starting at this new index. (The value can have a fractional part. In this case it is always rounded down to obtain the subimage that is drawn.)

image_speed The speed with which we cycle through the subimages. A value of 1 indicates that each step we get the next image. Smaller values will switch subimages slower, drawing each subimage multiple times. Larger values will skip subimages to make the motion faster. Sometimes you want a particular subimage to be visible and don't want the program to cycle through all of them. This can be achieved by setting the speed to 0 and choosing the correct subimage. For example, assume you have an object that can rotate and you create a sprite that has subimages for a number of orientations (counter-clockwise). Then, in the step event of the object you can set

```
{
    image_index = direction * image_number/360;
    image_speed = 0;
}
```

depth Normally images are drawn in the order in which the instances are created. You can change this by setting the image depth. The default value is 0, unless you set it to a different value in the object properties. The higher the value the further the instance is away. (You can also use negative values.) Instances with higher depth will lie behind instances with a lower depth. Setting the depth will guarantee that the instances are drawn in the order you want (e.g. the plane in front of the cloud). Background instances should have a high (positive) depth, and foreground instances should have a low (negative) depth.

image_xscale A scale factor to make larger or smaller images. A value of 1 indicates the normal size. You must separately set the horizontal xscale and vertical yscale. Changing the scale also changes the values for the image width and height and influences collision events as you might expect. Changing the scale can be used to get a 3-D effect. You can use a value of -1 to mirror the sprite horizontally.

image_yscale The vertical yscale. 1 is no scaling. You can use a value of -1 to flip the sprite vertically.

image_angle The angle with which the sprite is rotated. You specify this in degrees, counterclockwise. A value of 0 indicates no rotation.

image_alpha Transparency (alpha) value to use when drawing the image. A value of 1 is the normal opaque setting; a value of 0 is completely transparent.

image_blend Blending color used when drawing the sprite. A value of c_white is the default. When you specify a different value the image is blended with this color. This can be used to colorize the sprite on the fly. **This**

variable can not be set in the Lite Edition!

bbox_left* Left side of the bounding box of the instance in the room, as defined by its image (taking scaling into account).

bbox_right* Right side of the bounding box of the instance in the room.

bbox_top* Top side of the bounding box of the instance in the room.

bbox_bottom* Bottom side of the bounding box of the instance in the room.

Backgrounds

Each room can have up to 8 backgrounds. Also it has a background color. All aspects of these backgrounds you can change in a piece of code using the following variables (note that some are arrays that range from 0 to 7, indicating the different backgrounds):

background_color Background color for the room.

background_showcolor Whether to clear the window in the background color.

background_visible[0..7] Whether the particular background image is visible.

background_foreground[0..7] Whether the background is actually a foreground.

background_index[0..7] Background image index for the background.

background_x[0..7] X position of the background image.

background_y[0..7] Y position of the background image.

background_width[0..7]* Width of the background image.

background_height[0..7]* Height of the background image.

background_hscaled[0..7] Whether horizontally tiled.

background_vscaled[0..7] Whether vertically tiled.

background_xscale[0..7] Horizontal scaling factor for the background. (This must be positive; you cannot use a negative value to mirror the background.)

background_yscale[0..7] Vertical scaling factor for the background. (This must be positive; you cannot use a negative value to flip the background.)

background_hspeed[0..7] Horizontal scrolling speed of the background (pixels per step).

background_vspeed[0..7] Vertical scrolling speed of the background (pixels per step).

background_blend[0..7] Blending color to use when drawing the background. A value of `c_white` is the default. **Only available in the Standard Edition!**

background_alpha[0..7] Transparency (alpha) value to use when drawing the background. A value of 1 is the normal setting; a value of 0 is completely transparent.

Drawing sprites and backgrounds

Objects normally have a sprite associated to it that is drawn. But you can use the draw event to draw other things. This section and the next couple give you information on what is possible. First of all, there are functions to draw sprites and backgrounds in different ways. These give you more control over the appearance of the sprite. Also you can draw (parts of) backgrounds.

draw_sprite(sprite, subimg, x, y) Draws subimage subimg (-1 = current) of the sprite with its origin at position (x,y). (Without color blending and no alpha transparency.)

draw_sprite_stretched(sprite, subimg, x, y, w, h) Draws the sprite stretched so that it fills the region with top-left corner (x,y) and width w and height h.

draw_sprite_tiled(sprite, subimg, x, y) Draws the sprite tiled so that it fills the entire room. (x,y) is the place where one of the sprites is drawn.

draw_sprite_part(sprite, subimg, left, top, width, height, x, y) Draws the indicated part of subimage subimg (-1 = current) of the sprite with the top-left corner of the part at position (x,y).

draw_sprite_ext(sprite, subimg, x, y, xscale, yscale, rot, color, alpha) Draws the sprite scaled with factors xscale and yscale and rotated counterclockwise over rot degrees. color is the blending color (use c_white for no blending) and alpha indicates the transparency factor with which the images is merged with its background. A value of 0 makes the sprite completely transparent. A value of 1 makes it completely solid. This function can create great effect (for example partially transparent explosions).

draw_background(back, x, y) Draws the background at position (x,y). (Without color blending and no alpha transparency.)

draw_background_stretched(back, x, y, w, h) Draws the background stretched to the indicated region.

draw_background_tiled(back, x, y) Draws the background tiled so that it fills the entire room.

draw_background_part(back, left, top, width, height, x, y) Draws the indicated part of the background with the top-left corner of the part at position (x,y).

The following functions are extended functions of the ones indicated above. ***These extended versions can not be used in the Lite Edition!***

draw_sprite_stretched_ext(sprite, subimg, x, y, w, h, color, alpha) Draws the sprite stretched so that it fills the region with top-left corner (x,y) and width w and height h. color is the blending color and alpha indicates the transparency setting.

draw_sprite_tiled_ext(sprite, subimg, x, y, xscale, yscale, color, alpha) Draws the sprite tiled so that it fills the entire room but now with scale factors and a color and transparency setting.

draw_sprite_part_ext(sprite, subimg, left, top, width, height, x, y, xscale, yscale, color, alpha) Draws the indicated part of subimage subimg (-1 = current) of the sprite with the top-left corner of the part at position (x,y) but now with scale factors and a color and transparency setting.

draw_sprite_general(sprite, subimg, left, top, width, height, x, y, xscale, yscale, rot, c1, c2, c3, c4, alpha) The most general drawing function. It draws the indicated part of subimage subimg (-1 = current) of the sprite with the top-left corner of the part at position (x,y) but now with scale factors, a rotation angle, a color for each of the four vertices (top-left, top-right, bottom-right, and bottom-left), and an alpha transparency value. Note that rotation takes place around the top-left corner of the part.

draw_self() This command is exactly the same as **draw_sprite_ext()** except it will use the instances own variables to draw itself (x,y, scale, angle etc.) This provides the same action as if the instance was draw without a script.

draw_background_ext(back, x, y, xscale, yscale, rot, color, alpha) Draws the background scaled and rotated with blending color (use c_white for no blending) and transparency alpha (0-1).

draw_background_stretched_ext(back, x, y, w, h, color, alpha) Draws the background stretched to the indicated region. color is the blending color and alpha indicates the transparency setting.

draw_background_tiled_ext(back, x, y, xscale, yscale, color, alpha) Draws the background tiled so that it fills the entire room but now with scale factors and a color and transparency setting.

draw_background_part_ext(back, left, top, width, height, x, y, xscale, yscale, color, alpha) Draws the indicated part of the background with the top-left corner of the part at position (x,y) but now with scale factors and a color and transparency setting.

draw_background_general(back, left, top, width, height, x, y, xscale, yscale, rot, c1, c2, c3, c4, alpha)

The most general drawing function. It draws the indicated part of the background with the top-left corner of the part at position (x,y) but now with scale factors, a rotation angle, a color for each of the four vertices (top-left, top-right, bottom-right, and bottom-left), and an alpha transparency value. Note that rotation takes place around the top-left corner of the part.

Drawing Shapes

There is a whole collection of functions available to draw different shapes. Also there are functions to draw text (see next section). You can only use these in the drawing event of an object; these functions in general don't make any sense anywhere else in code. Realize that collisions between instances are determined by their sprites (or masks) and not by what you actually draw. The following drawing functions exist that can be used to draw basic shapes.

draw_clear(col) Clears the entire room in the given color (no alpha blending).

draw_clear_alpha(col,alpha) Clears the entire room in the given color and alpha value (in particular useful for surfaces).

draw_point(x,y) Draws a point at (x,y) in the current color.

draw_line(x1,y1,x2,y2) Draws a line from (x1,y1) to (x2,y2).

draw_line_width(x1,y1,x2,y2,w) Draws a line from (x1,y1) to (x2,y2) with width w.

draw_rectangle(x1,y1,x2,y2,outline) Draws a rectangle. *outline* indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_roundrect(x1,y1,x2,y2,outline) Draws a rounded rectangle. *outline* indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_triangle(x1,y1,x2,y2,x3,y3,outline) Draws a triangle. *outline* indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_circle(x,y,r,outline) Draws a circle at (x,y) with radius r. *outline* indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_ellipse(x1,y1,x2,y2,outline) Draws an ellipse. *outline* indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_set_circle_precision(precision) Sets the precision with which circles are drawn, that is, the number of segments they consist of. The precision must lie between 4 and 64 and must be dividable by 4. This is also used for drawing ellipses and rounded rectangles.

draw_arrow(x1,y1,x2,y2,size) Draws an arrow from (x1,y1) to (x2,y2). *size* indicates the size of the arrow in pixels.

draw_button(x1,y1,x2,y2,up) Draws a button, *up* indicates whether up (1) or down (0).

draw_path(path,x,y,absolute) With this function you can draw the indicated path in the room with its start at position (x,y). If *absolute* is true the path is drawn at the position where it was defined and the values of x and y are ignored.

draw_healthbar(x1,y1,x2,y2,amount,backcol,mincol,maxcol,direction,showback,showborder)
With this function you can draw a healthbar (or any other bar that indicates some value, like e.g. the damage). The arguments x1, y1, x2 and y2 indicate the total area for the bar. *amount* indicates the percentage of the bar that must be filled (must lie between 0 and 100). *backcol* is the color of the background for the bar. *mincol* and *maxcol* indicate the color when the amount is 0 and 100 respectively. For an amount in between the color is interpolated. So you can easily make a bar that goes e.g. from green to red. The *direction* is the direction in which the bar is drawn. 0 indicates that the bar is anchored at the left, 1 at the right, 2 at the top and 3 at the bottom. Finally *showback* indicates whether a background box must be shown and *showborder* indicated whether the box and bar should have a black border line.

Most of the above functions use the color and alpha setting that can be changed with following functions.

draw_set_color(col) Sets the drawing color to be used from now on for drawing primitives.

draw_set_alpha(alpha) Sets the alpha transparency value to be used from now on for drawing primitives. Should lie in the range 0-1. 0 is fully transparent, 1 is fully opaque.

draw_get_color() Returns the drawing color used for drawing primitives.

draw_get_alpha() Returns the alpha value used for drawing primitives.

A whole range of predefined colors is available:

c_aqua
c_black
c_blue
c_dkgray

```
c_fuchsia
c_gray
c_green
c_lime
c_ltgray
c_maroon
c_navy
c_olive
c_orange
c_purple
c_red
c_silver
c_teal
c_white
c_yellow
```

The following functions can help you to create the colors you want.

make_color_rgb(red,green,blue) Returns a color with the indicated red, green, and blue components, where red, green and blue must be values between 0 and 255.

make_color_hsv(hue,saturation,value) Returns a color with the indicated hue, saturation and value components (each between 0 and 255).

color_get_red(col) Returns the red component of the color.

color_get_green(col) Returns the green component of the color.

color_get_blue(col) Returns the blue component of the color.

color_get_hue(col) Returns the hue component of the color.

color_get_saturation(col) Returns the saturation component of the color.

color_get_value(col) Returns the value component of the color.

merge_color(col1,col2,amount) Returns a merged color of col1 and col2. The merging is determined by amount. A value of 0 corresponds to col1, a value of 1 to col2, and values in between to merged values.

The following miscellaneous functions exist.

draw_getpixel(x,y) Returns the color of the pixel corresponding to position (x,y) in the room. This is not very fast, so use with care.

screen_save(fname) Saves a png image of the screen in the given filename. Useful for making screenshots.

screen_save_part(fname,x,y,w,h) Saves part of the screen in the given png filename.

Fonts and Text

In games you sometimes need to draw texts. To draw a text you have to specify the font to use. Fonts can be defined by creating font resources (either in the *GameMaker* program or using the functions to create resources). There are different functions to draw texts in different way. In each function you specify the position of the text on the screen. There are two functions to set the horizontal and vertical alignment of the text with respect to that position.

For text drawing the following functions exist:

draw_set_font(font) Sets the font that will be used when drawing text. Use -1 to set the default font (Arial 12).

draw_set_halign(halign) Sets the horizontal alignment used when drawing text. Choose one of the following constants as values:

`fa_left`
`fa_center`
`fa_right`

draw_set_valign(valign) Sets the vertical alignment used when drawing text. Choose one of the following constants as values:

`fa_top`
`fa_middle`
`fa_bottom`

draw_text(x,y,string) Draws the string at position (x,y), using the drawing color and alpha. A# symbol or carriage return chr(13) or linefeed chr(10) are interpreted as newline characters. In this way you can draw multi-line texts. (Use # to get the # symbol itself.)

draw_text_ext(x,y,string,sep,w) Similar to the previous routine but you can specify two more things. First of all, *sep* indicates the separation distance between the lines of text in a multiline text. Use -1 to get the default distance. Use *w* to indicate the width of the text in pixels. Lines that are longer than this width are split up at spaces or - signs. Use -1 to not split up lines.

string_width(string) Width of the string in the current font as it would be drawn using the `draw_text()` function. Can be used for precisely positioning graphics.

string_height(string) Height of the string in the current font as it would be drawn using the `draw_text()` function.

string_width_ext(string,sep,w) Width of the string in the current font as it would be drawn using the `draw_text_ext()` function. Can be used for precisely positioning graphics.

string_height_ext(string,sep,w) Height of the string in the current font as it would be drawn using the `draw_text_ext()` function.

The following routines allow you to draw scaled and rotated text and also to use gradient colors on texts. ***These functions are only available in the Standard Edition!***

draw_text_transformed(x,y,string,xscale,yscale,angle) Draws the string at position (x,y) in the same way as above, but scale it horizontally and vertically with the indicated factors and rotate it counter-clockwise over *angle* degrees.

draw_text_ext_transformed(x,y,string,sep,w,xscale,yscale,angle) Combines the function `draw_text_ext` and `draw_text_transformed`. It makes it possible to draw a multi-line text rotated and scaled.

draw_text_color(x,y,string,c1,c2,c3,c4,alpha) Draws the string at position (x,y) like above. The four colors specify the colors of the top-left, top-right, bottom-right, and bottom-left corner of the text. *alpha* is the alpha transparency to be used (0-1).

draw_text_ext_color(x,y,string,sep,w,c1,c2,c3,c4,alpha) Similar to `draw_text_ext()` but with colored vertices.

draw_text_transformed_color(x,y,string,xscale,yscale,angle,c1,c2,c3,c4,alpha) Similar to `draw_text_transformed()` but with colored vertices.

```
draw_text_ext_transformed_color(x,y,string,sep,w,xscale,yscale,angle,c1,c2,c3,c4,alpha)
```

Similar to `draw_text_ext_transformed()` but with colored vertices.

Advanced drawing functions

This functionality is only available in the Standard Edition of GameMaker.

Above, a number of basic drawing functions have been described. Here you find a number of additional functions that offer you a lot more possibilities. First of all there are functions to draw shapes with gradient colors. Secondly there are functions to draw more general polygons, and finally there is the possibility to draw texture mapped polygons.

The following extended versions of the basic drawing functions exist. each of them gets extra color parameters that are used to determine the color at different vertices. The standard drawing color is not used in these functions.

draw_point_color(x,y,col1) Draws a point at (x,y) in the given color.

draw_line_color(x1,y1,x2,y2,col1,col2) Draws a line from (x1,y1) to (x2,y2), interpolating the color between col1 and col2.

draw_line_width_color(x1,y1,x2,y2,w,col1,col2) Draws a line from (x1,y1) to (x2,y2) with width w interpolating the color between col1 and col2.

draw_rectangle_color(x1,y1,x2,y2,col1,col2,col3,col4,outline) Draws a rectangle. The four colors indicated the colors at the top-left, top-right, bottom-right, and bottom-left vertex. outline indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_roundrect_color(x1,y1,x2,y2,col1,col2,outline) Draws a rounded rectangle. col1 is the color in the middle and col2 the color at the boundary. outline indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_triangle_color(x1,y1,x2,y2,x3,y3,col1,col2,col3,outline) Draws a triangle. The three colors are the colors of the three vertices which is interpolated over the triangle. outline indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_circle_color(x,y,r,col1,col2,outline) Draws a circle at (x,y) with radius r. col1 is the color in the middle and col2 the color at the boundary. outline indicates whether only the outline must be drawn (true) or it should be filled (false).

draw_ellipse_color(x1,y1,x2,y2,col1,col2,outline) Draws an ellipse. col1 is the color in the middle and col2 the color at the boundary. outline indicates whether only the outline must be drawn (true) or it should be filled (false).

You can also draw larger primitives. This works slightly different. You begin by specifying the primitive you want to draw. Next you specify the vertices for it, and finally you end the primitive, at which moment it is drawn. There are six types of primitives:

pr_pointlist The vertices are a set of points.

pr_linelist The vertices are a set of line segments. Each pair of vertices forms a line segment. So there must be an even set of vertices.

pr_linestrip The vertices form a polyline with the first connected to the second, the second to the third, etc. The last one is not connected to the first one. You have to specify an extra copy of the first vertex for this.

pr_trianglelist The vertices are a set of triangles. Each triple of vertices forms a triangle. So the number of vertices must be a multiple of 3.

pr_trianglestrip The vertices again form triangles but this time it works slightly different. The first three form the first triangle. The last two of these vertices, together with the next vertex, form the second triangle, etc. So each new vertex specifies a new triangle, connected to the previous one.

pr_trianglefan Similar to a triangle list but this time the first vertex is part of all the triangles. Again, each new vertex specifies a new triangle, connected to the previous vertex and the first vertex.

The following functions exist for drawing primitives

draw_primitive_begin(kind) Start a primitive of the indicated kind.

draw_vertex(x,y) Add vertex (x,y) to the primitive, using the color and alpha value set before.

draw_vertex_color(x,y,col,alpha) Add vertex (x,y) to the primitive, with its own color and alpha value. This allows you to create primitives with smoothly changing color and alpha values.

draw_primitive_end() End the description of the primitive. This function actually draws it.

Finally, it is possible to draw primitives using sprites or backgrounds as textures. When using a texture the image is placed

on the primitive, reshaping it to fit the primitive. Textures are used to add detail to primitives, e.g. a brick wall. To use textures you first must obtain the id of the texture you want to use. For this the following functions exist:

sprite_get_texture(spr, subimg) Returns the id of the texture corresponding to subimage subimg of the indicated sprite.

background_get_texture(back) Returns the id of the texture corresponding to the indicated background.

A selected texture might not yet be in video memory. The system will put it there once you need it but sometimes you want to decide this yourself. For this the following two functions exist:

texture_preload(texid) Puts the texture immediately into video memory.

texture_set_priority(texid, prio) When there is too little video memory some will be removed temporarily to make room for others that are needed. The ones with lowest priority are removed first. Default, all have priority 0 but you can change the priority here. (Use positive values!)

To add textures to primitives you must specify which parts of the textures must be put where on the primitive. Positions in the texture are indicated with values between 0 and 1 but there is a problem here. Sizes of textures must be powers of 2 (so e.g. 32x32 or 64x64). If you want to use sprites or background as textures you better make sure they have such a size. If not, the test will be blank. To find out which part of the texture is actually used you can use the following two functions. They return a value between 0 and 1 that indicates the width or height of the actual part of the texture being used. Specifying this value as texture coordinate will indicate the right or bottom side of the texture.

texture_get_width(texid) Returns the width of the texture with the given id. The width lies in the range 0-1.

texture_get_height(texid) Returns the height of the texture with the given id. The height lies in the range 0-1.

To draw textured primitives you use the following functions:

draw_primitive_begin_texture(kind, texid) Start a primitive of the indicated kind with the given texture.

draw_vertex_texture(x, y, xtex, ytex) Add vertex (x,y) to the primitive with position (xtex,ytex) in the texture, blending with the color and alpha value set before. xtex and ytex should normally lie between 0 and 1 but also larger values can be used, leading to a repetition of the texture (see below).

draw_vertex_texture_color(x, y, xtex, ytex, col, alpha) Add vertex (x,y) to the primitive with position (xtex,ytex) in the texture, blending with its own color and alpha value.

draw_primitive_end() End the description of the primitive. This function actually draws it.

There are three functions that influence how textures are drawn:

texture_set_interpolation(linear) Indicates whether to use linear interpolation (true) or pick the nearest pixel (false). Linear interpolation gives smoother textures but can also be a bit blurry and sometimes costs extra time. This setting also influence the drawing of sprites and background. Default is false. (This can also be changed in the global game settings.)

texture_set_blending(blend) Indicates whether to use blending with colors and alpha values. Switching this off might be faster on old hardware. This setting also influence the drawing of sprites and background. Default is true.

texture_set_repeat(repeat) Indicates whether to use repeat the texture. This works as follows. As indicated above texture coordinates lie in the range 0-1. If you specify a value larger than 1, default the rest is not drawn. By setting repeat to true the texture is repeated. Note that sprites and backgrounds are always drawn without repeating. So once you draw a sprite or background this value is reset to false. Default is false.

There are two more function that are not only useful for drawing textures. Normally primitives are blended with the background using the alpha value. You can actually indicate how this must happen. Besides the normal mode it is possible to indicate that the new color must be added to the existing color or subtracted from the existing color. This can be used to create e.g. spot lights or shadows. Also it is possible to sort of take the maximum of the new and existing color. This can avoid certain saturation effects that you can get with adding. Note that both subtracting and maximum do not take the alpha value fully into account. (DirectX does not allow this.) So you better make sure the outside area is black. There are two functions. The first one only gives you the four options described above. The second function gives you a lot more possibilities. You should experiment a bit with the settings. If used effectively they can be used to create e.g. interesting explosion or halo effects.

draw set blend mode(mode) Indicates what blend mode to use. The following values are possible:

`bm_normal`, `bm_add`, `bm_subtract`, and `bm_max`. Don't forget to reset the mode to normal after use because otherwise also other sprites and even the backgrounds are drawn with the new blend mode.

`draw_set_blend_mode_ext(src,dest)` Indicates what blend mode to use for both the source and destination color. The new color is some factor times the source and another factor times the destination. These factors are set with this function. To understand this, the source and destination both have a red, green, blue, and alpha component. So the source is (Rs, Gs, Bs, As) and the destination is (Rd, Gd, Bd, Ad). All are considered to lie between 0 and 1. The blend factors you can choose for source and destination are:

- `bm_zero`: Blend factor is (0, 0, 0, 0).
- `bm_one`: Blend factor is (1, 1, 1, 1).
- `bm_src_color`: Blend factor is (Rs, Gs, Bs, As).
- `bm_inv_src_color`: Blend factor is (1-Rs, 1-Gs, 1-Bs, 1-As).
- `bm_src_alpha`: Blend factor is (As, As, As, As).
- `bm_inv_src_alpha`: Blend factor is (1-As, 1-As, 1-As, 1-As).
- `bm_dest_alpha`: Blend factor is (Ad, Ad, Ad, Ad).
- `bm_inv_dest_alpha`: Blend factor is (1-Ad, 1-Ad, 1-Ad, 1-Ad).
- `bm_dest_color`: Blend factor is (Rd, Gd, Bd, Ad).
- `bm_inv_dest_color`: Blend factor is (1-Rd, 1-Gd, 1-Bd, 1-Ad).
- `bm_src_alpha_sat`: Blend factor is (f, f, f, 1); $f = \min(As, 1-Ad)$.

For example, the normal blending mode sets the source blending to `bm_src_alpha` and the destination blending to `bm_inv_src_alpha`. Don't forget to reset the mode to normal after use because otherwise also other sprites and even the backgrounds are drawn with the new blend mode.

Drawing texture primitives is a bit of work but can lead to great results. You can even use it to make fake 3D games.

Drawing Surfaces

This functionality is only available in the Standard Edition of GameMaker.

In certain situations you might want to paint not directly on the screen but on a canvas that can then later be used to paint things on the screen. Such a canvas is called a surface. For example, you want to let the user draw on the screen. The paint should not be drawn on the screen (because it will be removed each next step), but instead you want to draw it on a separate surface that is copied onto the screen in each step. Or you want to use a texture that changes over time.

Surfaces make this all possible. They are actually rather simple to use. You first create a surface. Next you indicate that further drawing should happen on this surface. From that moment on all drawing functions operate on the surface. Once you are done you reset the drawing target and further drawing happens on the screen again. You can draw the surface on the screen in many different ways or use it as a texture. There are though a few things you must be aware of. See the remarks at the end.

The following functions exist to deal with surfaces

surface_create(w,h) Creates a surface of the indicated width and height. Returns the id of the surface, which must be used in all further calls. Note that the surface will not be cleared. This is the responsibility of the user. (Set it as a target and call the appropriate clear function.)

Please Note: Many older graphics cards require "Power of 2" textures/surfaces for use in 3D. That is, width and height sizes must be one of; 2,4,8,16,32,64,128,256,512 or 1024 pixels in size. While width and height don't have to be the same (i.e. square), you would be advised to try and keep them to these sizes for maximum compatability.

surface_free(id) Frees the memory used by the surface.

surface_exists(id) Returns whether the surface with the indicated id exists.

surface_get_width(id) Returns the width of the surface.

surface_get_height(id) Returns the height of the surface.

surface_get_texture(id) Returns the texture corresponding to the surface. This can be used to draw textured objects with the image of the surface.

surface_set_target(id) Sets the indicated surface as the drawing target. All subsequent drawing happens on this surface. It resets the projection to simply cover the surface.

surface_reset_target() Resets the drawing target to the normal screen.

surface_getpixel(id,x,y) Returns the color of the pixel corresponding to position (x,y) in the surface. This is not very fast, so use with care.

surface_save(id,fname) Saves a png image of the surface in the given filename. Useful for making screenshots.

surface_save_part(id,fname,x,y,w,h) Saves part of the surface in the given png filename.

draw_surface(id,x,y) Draws the surface at position (x,y). (Without color blending and no alpha transparency.)

draw_surface_stretched(id,x,y,w,h) Draws the surface stretched to the indicated region.

draw_surface_tiled(id,x,y) Draws the surface tiled so that it fills the entire room.

draw_surface_part(id,left,top,width,height,x,y) Draws the indicated part of the surface with its origin at position (x,y).

draw_surface_ext(id,x,y,xscale,yscale,rot,color,alpha) Draws the surface scaled and rotated with blending color (use c_white for no blending) and transparency alpha (0-1).

draw_surface_stretched_ext(id,x,y,w,h,color,alpha) Draws the surface stretched to the indicated region. color is the blending color and alpha indicates the transparency setting.

draw_surface_tiled_ext(id,x,y,xscale,yscale,color,alpha) Draws the surface tiled so that it fills the entire room but now with scale factors and a color and transparency setting.

draw_surface_part_ext(id,left,top,width,height,x,y,xscale,yscale,color,alpha) Draws the indicated part of the surface with its origin at position (x,y) but now with scale factors and a color and

transparency setting.

draw_surface_general(id,left,top,width,height,x,y,xscale,yscale,rot,c1,c2,c3,c4,alpha)

The most general drawing function. It draws the indicated part of the surface with its origin at position (x,y) but now with scale factors, a rotation angle, a color for each of the four vertices (top-left, top-right, bottom-right, and bottom-left), and an alpha transparency value.

surface_copy(destination,x,y,source) Copies the source surface at position (x,y) in the destination surface. (Without any form of blending.)

surface_copy_part(destination,x,y,source,xs,ys,ws,hs) Copies the indicated part of the source surface at position (x,y) in the destination surface. (Without any form of blending.)

Note that there are no functions to copy part of the screen to a surface. (This is impossible due to possible format differences between the screen and the surfaces.) If this is required you must set a surface as render target and next draw the room. You can then use the surface copying routines to get parts of it.

Note that you can also create sprites and backgrounds from surfaces. See the section on changing resources for more information.

Some care must be taken when using these functions. In particular please notice the following:

- Surfaces will be destroyed after **display_reset()** is called. You will have to manually recreate and draw them again after you've called **display_reset()**
- You should use **surface_exists()** to see if your surface has been destroyed before using it. If it has been destroyed, then you must recreated it before drawing it.
- You should never change the drawing target while you are actually drawing on the screen, that is, never use it in drawing events. This will cause serious problems with the projection and viewport.
- For reasons of speed, the surface is maintained in videomemory only. As a result, you might loose the surface when e.g. the screen resolution changes, the screensaver pops up, or CTRL-ALT-Delete is pressed.
- Surfaces will not be saved when saving a game.

Tiles

As you should know you can add tiles to rooms. A tile is a part of a background resource. Tiles are just visible images. They do not react to events and they do not generate collisions. As a result, tiles are handled a lot faster than objects. Anything that does not need events or collisions can best be done through tiles. Also, often one better uses a tile for the nice graphics while a simple object is used to generate the collision events.

You actually have more control over tiles than you might think. You can add them when designing the room but you can also add them during the running of the game. You can change their position, and even scale them or make them partially transparent. A tile has the following properties:

- **background.** The background resource from which the tile is taken.
- **left, top, width, height.** The part of the background that is used.
- **x,y.** The position of the top left corner of the tile in the room.
- **depth.** The depth of the tile. You can choose any depth you like, making tiles appear between object instances.
- **visible.** Whether the tile is visible.
- **xscale, yscale.** Each tile can be drawn scaled (default is 1).
- **blend.** A blending color used when drawing the tile.
- **alpha.** An alpha value indicating tile transparency. 1 = not transparent, 0 = fully transparent.

To change the properties of a particular tile you need to know its id. When you add tiles when creating rooms the id is shown in the information bar at the bottom. There is also a function to find the id of a tile at a particular position.

The following functions exist that deal with tiles:

tile_add(background,left,top,width,height,x,y,depth) Adds a new tile to the room with the indicated values (see above for their meaning). The function returns the id of the tile that can be used later on.

tile_delete(id) Deletes the tile with the given id.

tile_exists(id) Returns whether a tile with the given id exists.

tile_get_x(id) Returns the x-position of the tile with the given id.

tile_get_y(id) Returns the y-position of the tile with the given id.

tile_get_left(id) Returns the left value of the tile with the given id.

tile_get_top(id) Returns the top value of the tile with the given id.

tile_get_width(id) Returns the width of the tile with the given id.

tile_get_height(id) Returns the height of the tile with the given id.

tile_get_depth(id) Returns the depth of the tile with the given id.

tile_get_visible(id) Returns whether the tile with the given id is visible.

tile_get_xscale(id) Returns the xscale of the tile with the given id.

tile_get_yscale(id) Returns the yscale of the tile with the given id.

tile_get_background(id) Returns the background of the tile with the given id.

tile_get_blend(id) Returns the blending color of the tile with the given id.

tile_get_alpha(id) Returns the alpha value of the tile with the given id.

tile_set_position(id,x,y) Sets the position of the tile with the given id.

tile_set_region(id,left,top,width,height) Sets the region of the tile with the given id in its background.

tile_set_background(id,background) Sets the background for the tile with the given id.

tile_set_visible(id,visible) Sets whether the tile with the given id is visible.

tile_set_depth(id,depth) Sets the depth of the tile with the given id.

tile_set_scale(id,xscale,yscale) Sets the scaling of the tile with the given id.

tile_set_blend(id,color) Sets the blending color of the tile with the given id. **Only available in the Standard Edition!**

tile_set_alpha(id,alpha) Sets the alpha value of the tile with the given id.

The following functions deal with layers of tiles, that is, collections of tiles at the same depth.

tile_layer_hide(depth) Hides all tiles at the indicated depth layer.

tile_layer_show(depth) Shows all tiles at the indicated depth layer.

tile_layer_delete(depth) Deletes all tiles at the indicated depth layer.

tile_layer_shift(depth,x,y) Shifts all tiles at the indicated depth layer over the vector x,y. Can be used to create scrolling layers of tiles.

tile_layer_find(depth,x,y) Returns the id of the tile with the given depth at position (x,y). When no tile exists at the position -1 is returned. When multiple tiles with the given depth exist at the position the first one is returned.

tile_layer_delete_at(depth,x,y) Deletes the tile with the given depth at position (x,y). When multiple tiles with the given depth exist at the position they are all deleted.

tile_layer_depth(depth,newdepth) Changes the depth of all tiles at the indicated depth to the new depth. With this function you can move whole tile layers to a new depth.

The Display

The Display represents the whole area on the monitor. It has a size (typically 1024x768, or 1280x1024), a color depth, that is, the number of bits that are used to represent a single pixel (typically 16 = High Color or 32 = Full Color) and a refresh frequency, that is, the number of times per second the display is refreshed (typically between 60 and 120). These settings can normally be changed through the display properties. For games though, in particular when they run in full-screen mode, it is important to be able to change these settings. All these settings can be initialized for the game in the **Game Settings**. For use during game play the following functions exist. Note though that changing the settings during game play will result in a time delay as things have to be rebuilt. *The functions to set the mode are only available in the Standard Edition.*

display_get_width() Returns the width of the display in pixels.

display_get_height() Returns the height of the display in pixels.

display_get_colordepth() Returns the color depth in bits.

display_get_frequency() Returns the refresh frequency of the display.

display_set_size(w,h) Sets the width and height of the display in pixels. Returns whether this was successful. (Realize that only certain combinations are allowed.)

display_set_colordepth(coldepth) Sets the color depth. In general only 16 and 32 are allowed values. Returns whether successful.

display_set_frequency(frequency) Sets the refresh frequency for the display. Only few frequencies are allowed. Typically you could set this to 60 with a same room speed to get smooth 60 frames per second motion. Returns whether successful.

display_set_all(w,h,frequency,coldepth) Sets all at once. Use -1 for values you do not want to change. Returns whether successful.

display_test_all(w,h,frequency,coldepth) Tests whether the indicated settings are allowed. It does not change the settings. Use -1 for values you do not want to change. Returns whether the settings are allowed.

display_reset(AA) Resets the display settings to the ones when the program was started, and also allow you to change the current level of Full Screen Anti-Aliasing being used. Available levels are 0,2,4 and 8. GameMaker start up with 0.

display_aa This read-only variable will report the various levels of AA that a user's machine can display. It will do this by setting bits for the different levels, so for only 2xAA, this will report 2, for 2x and 4x availability it will report 6. For 8 and 4 it will report 12. For all 3 levels (2,4 and 8) it will report 14. To allow a user to set AA, use something like the code shown below..

```
if( display_aa&2 ) display_reset(2);
```

Sometimes it is useful to get information about the position of the mouse on the display or to change this position. For this the following functions exist:

display_mouse_get_x() Returns the x-coordinate of the mouse on the display.

display_mouse_get_y() Returns the y-coordinate of the mouse on the display.

display_mouse_set(x,y) Sets the position of the mouse on the display to the indicated values.

The window

The actual game happens in a window. This window has a number of properties, like whether it has a border, whether it is full screen, etc. Normally these are set in the **Game Settings**. But you can change them during the game. The following functions exist for this:

window_set_visible(visible) Sets whether the game window is visible. Clearly you normally want the window to remain visible during the whole game. The program will not receive keyboard events when the window is invisible.

window_get_visible() Returns whether the game window is visible.

window_set_fullscreen(full) Sets whether the window is shown in full screen mode.

window_get_fullscreen() Returns whether the window is shown in full screen mode.

window_set_showborder(show) Sets whether the border around the window is shown. (In full screen mode it is never shown.)

window_get_showborder() Returns whether the border around the window is shown in windowed mode.

window_set_showicons(show) Sets whether the border icons (iconize, maximize, close) are shown. (In full screen mode these are never shown.)

window_get_showicons() Returns whether the border icons are shown in windowed mode.

window_set_stayontop(stay) Sets whether the window must always stay on top of other windows.

window_get_stayontop() Returns whether the window always stays on top of other windows.

window_set_sizeable(sizeable) Sets whether the window is sizeable by the player. (The player can only size it when the border is shown and the window is not in full screen mode.)

window_get_sizeable() Returns whether the window is sizeable by the player.

window_set_caption(caption) Sets the caption string for the window. Normally you specify this when defining the room and it can be changed using the variable `room_caption`. So this function is normally not useful, unless you draw the room yourself rather than letting *GameMaker* do it. The caption is only visible when the window has a border and when it is not in full screen mode.

window_get_caption() Returns the window caption.

window_set_cursor(curs) Sets the mouse cursor used in the window. You can use the following constant:

```
cr_default
cr_none
cr_arrow
cr_cross
cr_beam
cr_size_nesw
cr_size_ns
cr_size_nwse
cr_size_we
cr_uparrow
cr_hourglass
cr_drag
cr_nodrop
cr_hsplit
cr_vsplit
cr_multidrag
cr_sqlwait
cr_no
cr_appstart
cr_help
cr_handpoint
cr_size_all
```

In particular, to hide the mouse cursor, use `cr_none` as value.

window_get_cursor() Returns the cursor used in the window.

window_set_color(color) Sets the color of the part of the window that is not used for displaying the room.

window_get_color() Returns the window color.

window_set_region_scale(scale,adaptwindow) If the window is larger than the actual room normally the room is displayed in a region centered in the window. It is though possible to indicate that it must be scaled to fill the whole or part of the window. A value of 1 is no scaling. If you use a value of 0 the region will be scaled to fill the whole window. If you set it to a negative value it will be scaled to the maximal size inside the window while maintaining the aspect ratio (this is often what you want). `adaptwindow` indicates whether the window size must be adapted if the scaled room does not fit in. Adapting the window is only effective when the scale factor is positive.

window_get_region_scale() Returns the scale factor for the drawing region.

The window has a position on the screen and a size. (When we talk about position and size we always mean the client part of the window without the borders.) You can change these although you hardly ever do from within your game. Normally they are determined automatically or by the player. The following functions can be used to change the window position and size. Note that these functions deal with the windowed mode. If the window is in full screen mode they can still be used but will only have effect when switching full screen mode off.

window_set_position(x,y) Sets the position of the (client part of the) window to the indicated position.

window_set_size(w,h) Sets the size of the (client part of the) window to the indicated size. Note that is the indicated size is too small to fit the drawing region it is kept large enough for the region to fit it.

window_set_rectangle(x,y,w,h) Sets the position and size of the window rectangle. (Does both previous routines in one step.)

window_center() Centers the window on the screen.

window_default() Gives the window the default size and position (centered) on the screen.

window_get_x() Returns the current x-coordinate of the window.

window_get_y() Returns the current y-coordinate of the window.

window_get_width() Returns the current width of the window.

window_get_height() Returns the current height of the window.

Again, you probably never want to use any of the window positioning functions as *GameMaker* takes care of these automatically.

In rare cases you might want to know the position of the mouse with respect to the window. (Normally you always use the mouse position with respect to the room or with respect to a view.) The following functions exist for this.

window_mouse_get_x() Returns the x-coordinate of the mouse in the window.

window_mouse_get_y() Returns the y-coordinate of the mouse in the window.

window_mouse_set(x,y) Sets the position of the mouse in the window to the indicated values.

Views

As you should know you can define up to eight different views when designing rooms. A view is defined by its view area in the room and its viewport on the screen (or to be precise in the drawing region within the window). Using views you can show different parts of the room at different places on the screen. Also, you can make sure that a particular object always stays visible.

You can control the views from within code. You can make views visible and invisible and change the place or size of the views in the drawing region or the position and size of the view in the room (which is in particular useful when you indicate no object to be visible). You can change the size of the horizontal and vertical border around the visible object, and you can indicate which object must remain visible in the views. The latter is very important when the important object changes during the game. For example, you might change the main character object based on its current status. Unfortunately, this does mean that it is no longer the object that must remain visible. This can be remedied by one line of code in the creation event of all the possible main objects (assuming this must happen in the first view):

```
{  
    view_object[0] = object_index;  
}
```

The following variables exist that influence the view. All, except the first two are arrays ranging from 0 (the first view) to 7 (the last view).

view_enabled Whether views are enabled or not.

view_current* The currently drawn view (0-7). Use this only in the drawing event. You can for example check this variable to draw certain things in only one view. Variable cannot be changed.

view_visible[0..7] Whether the particular view is visible on the screen.

view_xview[0..7] X position of the view in the room.

view_yview[0..7] Y position of the view in the room.

view_wview[0..7] Width of the view in the room.

view_hview[0..7] Height of the view in the room.

view_xport[0..7] X-position of the viewport in the drawing region.

view_yport[0..7] Y-position of the viewport in the drawing region.

view_wport[0..7] Width of the viewport in the drawing region.

view_hport[0..7] Height of the viewport in the drawing region.

view_angle[0..7] Rotation angle used for the view in the room (counter-clockwise in degrees).

view_hborder[0..7] Size of horizontal border around the visible object (in pixels).

view_vborder[0..7] Size of vertical border around visible object (in pixels).

view_hspeed[0..7] Maximal horizontal speed of the view.

view_vspeed[0..7] Maximal vertical speed of the view.

view_object[0..7] Object whose instance must remain visible in the view. If there are multiple instances of this object only the first one is followed. You can also assign an instance id to this variable. In that case the particular instance is followed.

Note that the size of the image on the screen is decided based on the visible views at the beginning of the room. If you change views during the game, they might no longer fit on the screen. The screen size though is not adapted automatically. So if you need this you have to do it yourself, using the following functions:

window_set_region_size(w,h,adaptwindow) Set the width and height of the drawing region in the window. `adaptwindow` indicates whether the window size must be adapted if the region does not fit in. The window size will always be adapted if you use fixed scaling. (See the function `window_set_region_scale()`.)

window_get_region_width() Returns the current width of the drawing region.

window_get_region_height() Returns the current height of the drawing region.

In a game you often need the position of the mouse cursor. Normally you use for this the variables `mouse_x` and `mouse_y`. When there are multiple views, these variables give the mouse position with respect to the view the mouse is in. Sometimes

though, you might need the mouse position with respect to a particular view, also when it is outside that view. For this the following functions exist.

window_view_mouse_get_x(id) Returns the x-coordinate of the mouse with respect to the view with index `id`.
window_view_mouse_get_y(id) Returns the y-coordinate of the mouse with respect to the view with index `id`.
window_view_mouse_set(id,x,y) Sets the position of the mouse with respect to the view with index `id`.
window_views_mouse_get_x() Returns the x-coordinate of the mouse with respect to the view it is in (same as `mouse_x`).
window_views_mouse_get_y() Returns the y-coordinate of the mouse with respect to the view it is in (same as `mouse_y`).
window_views_mouse_set(x,y) Sets the position of the mouse with respect to the first view that is visible.

Repainting the screen

Normally at the end of each step the room is repainted on the screen. But in rare circumstances you need to repaint the room at other moments. This happens when your program takes over the control. For example, before sleeping a long time a repaint might be wanted. Also, when your code displays a message and wants to wait for the player to press a key, you need a repaint in between. There are two different routines to do this.

screen_redraw() Redraws the room by calling all draw events.

screen_refresh() Refreshes the screen using the current room image (not performing drawing events).

To understand the second function, you will need to understand more fully how drawing works internally. There is internally an image on which all drawing happens. This image is not visible on the screen. Only at the end of a step, after all drawing has taken place, is the screen image replaced by this internal image. (This is called double buffering.) The first function redraws the internal image and then refreshes the screen image. The second function only refreshes the image on the screen.

Now you should also realize why you cannot use drawing actions or functions in other events than drawing events. They will draw things on the internal image but these won't be visible on the screen. And when the drawing events are performed, first the room background is drawn, erasing all you drew on the internal image. But when you use `screen_refresh()` after your drawing, the updated image will become visible on the screen. So, for example, a script can draw some text on the screen, call the refresh function and then wait for the player to press a key, like in the following piece of code.

```
{
    draw_text(room_width/2,100,'Press any key to continue. ');
    screen_refresh();
    keyboard_wait();
}
```

Please realize that, when you draw in another event than the drawing event, you draw simply on the image, not in a view! So the coordinates you use are the same as if there are no views. Be careful when using this technique. Make sure you understand it first and realize that refreshing the screen takes some time.

When you are drawing the room yourself it can be useful to NOT let it be drawn automatic at all. For example, you might want to draw the room only every 5 steps. You can use the following functions for this:

set_automatic_draw(value) Indicates whether to automatically redraw the room (true, default) or not (false).

Finally there is a function with which you can set whether to synchronize the drawing with the refresh frequency of the monitor:

set_synchronization(value) Indicates whether to synchronize the drawing with the refresh frequency of the monitor.

You can also force a wait for the next vertical synchronization using the following function:

screen_wait_vsync() Waits for the next vertical synchronization of the monitor.

Sound and music

Sound plays a crucial role in computer games. Sounds are added to your game in the form of sound resources. Make sure that the names you use are valid variable names. As you will have seen you can indicate four different types of sound: normal sounds, background music, 3D sounds, and sounds that must be played through the media player.

Normal sounds are used for sound effects. In general wave files are used for this. Many of them can play at the same moment (even multiple instances of the same normal sound). You can apply all sorts of effects to them.

Background music typically consist of midi files but sometimes also wave files are used. Sound effects can be applied to it. The only difference with normal sounds is that only one background music can play at any moment. If you start one the current one is stopped.

3D sounds allow for 3D sound effects which is described below. They are mono sounds (wave or midi).

Finally, if you want to use another sound type, in particular mp3, these cannot be played through DirectX. As a result the normal media player must be used for this. This is much more limited. Only one sound can play at the same time. No effects can be applied (not even volume changes) and the timing for e.g. looping sounds is poor. There can also be delays in playing these sounds. You are strongly encouraged not to use them. (Some computers might also not support them)

Information on sound and music can be found in the following pages:

[Basic sound functions](#)

[Special effects](#)

[3D music](#)

[CD music](#)

Basic sound functions

There are five basic functions related to sounds, two to play a sound, one to check whether a sound is playing, and two to stop sounds. Most take the index of the sound as argument. The name of the sound represents its index. But you can also store the index in a variable, and use that.

sound_play(index) Plays the indicates sound once. If the sound is background music the current background music is stopped.

sound_loop(index) Plays the indicates sound, looping continuously. If the sound is background music the current background music is stopped.

sound_stop(index) Stops the indicates sound. If there are multiple sounds with this index playing simultaneously, all will be stopped.

sound_stop_all() Stops all sounds.

sound_isplaying(index) Returns whether (a copy of) the indicated sound is playing. Note that this functions returns true when the sound actually plays through the speakers. After you call the function to play a sound it does not immediately reach the speakers so the function might still return false for a while. Similar, when the sound is stopped you still hear it for a while (e.g. because of echo) and the function will still return true.

It is possible to use further sound effects. In particular you can change the volume and the pan, that is, whether the sound comes from the left or right speaker. In all these cases the volume can only be reduced. These functions do not work for files that play through the media player (like mp3 files).

sound_volume(index,value) Changes the volume for the indicated sound (0 = low, 1 = high).

sound_global_volume(value) Changes the global volume for all sounds (0 = low, 1 = high).

sound_fade(index,value,time) Changes the volume for the indicated sound to the new value(0 = low, 1 = high) during the indicated time (in milliseconds). This can be used to fade out or fade in music.

sound_pan(index,value) Changes the pan for the indicated sound (-1 = left, 0 = center, 1 = right).

sound_background_tempo(factor) Changes the tempo of the background music (if it is a midi file).

factor indicates the factor with which to multiply the tempo. So a value of 1 corresponds to the normal tempo. Larger values correspond to a faster tempo, smaller values to a slower tempo. Must lie between 0.01 and 100.

Besides midi and wave files (and mp3 file) there is actually a fourth type of file that can be played: direct music files. These have the extension .sgt. Such files though often refer to other files describing e.g. band or style information. To find these files, the sound system must know where they are located. To this end you can use the following functions to set the search directory for files. Note though that you must add the files yourself. *GameMaker* does not automatically include such additional files.

sound_set_search_directory(dir) Sets the directory in which direct music files are to be found. The dir string should not include the final backslash.

Special effects

This functionality is only available in the Standard Edition of Game Maker.

Special effects can be used to change the way sounds and background music sounds. Realize that sound effects only apply to wave files and midi files, not to mp3 files. This section describes the functions that exist for using and changing sound effects. Realize that to use these functions you need to have a good understanding of how sound and synthesizers work. No explanation of the different parameters is given here. Search the web or books for further informations.

To apply a sound effect to a particular sound you can either indicate this when defining the sound resource or you can use the following function

sound_effect_set(snd, effect) Sets a (combination of) sound effect(s) for the indicated sound. *effect* can be any of the following values:

```
se_none
se_chorus
se_echo
se_flanger
se_gargle
se_reverb
se_compressor
se_equalizer
```

You can set a combination of effects by adding up the values. So e.g. you can use

```
sound_effect_set(snd, se_echo+se_reverb);
```

to get a combination of echo and reverb effects.

All effects have some default settings. You can change these settings once an effect has been applied to a sound. The order here is crucial. You first apply the effect to the sound and next set the parameters for it. Once you reapply effects to the sound, the settings are gone and you have to set them again. Note that all parameters must lie in a particular range, which is indicated below. The following functions exist for changing effect parameters:

sound_effect_chorus(snd, wetdry, depth, feedback, frequency, wave, delay, phase) Sets the parameters for the chorus effect for the indicated sound. The following parameters can be set:

wetdry Ratio of wet (processed) signal to dry (unprocessed) signal. (range: 0 to 100, default 50)
depth Percentage by which the delay time is modulated by the low-frequency oscillator, in hundredths of a percentage point. (range: 0 to 100, default 25)
feedback Percentage of output signal to feed back into the effect's input. (range: -99 to 99, default 0)
frequency Frequency of the LFO. (range: 0 to 10, default 0)
wave Waveform of the LFO. (0 = triangle, 1 = wave, default 1)
delay Number of milliseconds the input is delayed before it is played back. (range: 0 to 20, default 0)
phase Phase differential between left and right LFOs. (range: 0 to 4, default 2)

sound_effect_echo(snd, wetdry, feedback, leftdelay, rightdelay, pandelay) Sets the parameters for the echo effect for the indicated sound. The following parameters can be set:

wetdry Ratio of wet (processed) signal to dry (unprocessed) signal. (range: 0 to 100, default 50)
feedback Percentage fed back into input (range: 0 to 100, default 0)
leftdelay Delay for left channel, in milliseconds. (range: 1 to 2000, default 333)
rightdelay Delay for right channel, in milliseconds. (range: 1 to 2000, default 333)

`pandelay` Whether to swap left and right delays with each successive echo. (0 = don't swap, 1 = swap, default 0)

`sound_effect_flanger(snd, wetdry, depth, feedback, frequency, wave, delay, phase)` Sets the parameters for the flanger effect for the indicated sound. The following parameters can be set:

`wetdry` Ratio of wet (processed) signal to dry (unprocessed) signal. (range: 0 to 100, default 50)

`depth` Percentage by which the delay time is modulated by the low-frequency oscillator, in hundredths of a percentage point. (range: 0 to 100, default 25)

`feedback` Percentage of output signal to feed back into the effect's input. (range: -99 to 99, default 0)

`frequency` Frequency of the LFO. (range: 0 to 10, default 0)

`wave` Waveform of the LFO. (0 = triangle, 1 = wave, default 1)

`delay` Number of milliseconds the input is delayed before it is played back. (range: 0 to 20, default 0)

`phase` Phase differential between left and right LFOs. (range: 0 to 4, default 2)

`sound_effect_gargle(snd, rate, wave)` Sets the parameters for the gargle effect for the indicated sound. The following parameters can be set:

`rate` Rate of modulation, in Hertz. (range: 1 to 1000, default 1)

`wave` Shape of the modulation wave. (0 = triangle, 1 = square, default 0)

`sound_effect_reverb(snd, gain, mix, time, ratio)` Sets the parameters for the reverb effect for the indicated sound. The following parameters can be set:

`gain` Input gain of signal, in decibels (dB). (range: -96 to 0, default 0)

`mix` Reverb mix, in dB. (range: -96 to 0, default 0)

`time` Reverb time, in milliseconds. (range: 0.001 to 3000, default 1000)

`ratio` Frequency ratio. (range: 0.001 to 0.999, default 0.001)

`sound_effect_compressor(snd, gain, attack, release, threshold, ratio, delay)` Sets the parameters for the compressor effect for the indicated sound. The following parameters can be set:

`gain` Output gain of signal after compression. (range: -60 to 60, default 0)

`attack` Time before compression reaches its full value. (range: 0.01 to 500, default 0.01)

`release` Speed at which compression is stopped after input drops below threshold. (range: 50 to 3000, default 50)

`threshold` Point at which compression begins, in decibels. (range: -60 to 0, default -10)

`ratio` Compression ratio. (range: 1 to 100, default 10)

`delay` Time after threshold is reached before attack phase is started, in milliseconds. (range: 0 to 4, default 0)

`sound_effect_equalizer(snd, center, bandwidth, gain)` Sets the parameters for the equalizer effect for the indicated sound. The following parameters can be set:

`center` Center frequency, in hertz. (range: 80 to 16000)

`bandwidth` Bandwidth, in semitones. (range: 1 to 36)

`gain` Gain. (range: -15 to 15)

3D music

This functionality is only available in the Standard Edition of GameMaker.

3D music refers to sound that has a position (and velocity) with respect to the listener. Although its most prominent use is in 3D games you can also effectively use it in 2D games. The idea is that a sound has a position in space. In all functions the listener is assumed to be at position (0,0,0). The system calculates how the listener would hear the sound and adapt it accordingly. The effect is especially good when you have a good speaker system but it already works on small speakers.

Besides a position, the sound can also have a velocity. This leads to well-known doppler effects which are correctly modelled. Finally the sound can have an orientation and, again, the sound is adapted accordingly.

GameMaker supports 3D music options through the functions below. They only work for sound resources that were indicated to be 3D. (The disadvantage is that 3D music will be mono, not stereo.)

sound_3d_set_sound_position(snd,x,y,z) Sets the position of the indicated sound with respect to the listener to the indicated position in space. Values on the x-axis increase from left to right, on the y-axis from down to up, and on the z-axis from near to far. The values are measured in meters. The volume with which the sound is heard depends on this measure in the same way as in the real world.

sound_3d_set_sound_velocity(snd,x,y,z) Sets the velocity of the indicated sound to the indicated vector in space. Please note that setting the velocity does not mean that the position changes. The velocity is only used for calculating doppler effects. So if you want to move the sound you must yourself change the position of the sound.

sound_3d_set_sound_distance(snd,minidist,maxdist) Sets the minimum distance at which the sound does no longer increase in loudness and the maximum distance at which the sound can no longer be heard. So when the distance lies between 0 and the minimum distance the sound is at maximal amplitude. When between the minimal distance and the maximal distance the amplitude slowly decreases until either the maximal distance is reached or the sound is anyway no longer audible. Default the minimum distance is 1 meter and the maximal distance is 1 billion meters.

sound_3d_set_sound_cone(snd,x,y,z,anglein,angleout,voloutside) Normally sound has the same amplitude at a given distance in all directions. You can set the sound cone to change this and make sound directional. x,y,z specify the direction of the sound cone. **anglein** specifies the inside angle. If the listener is inside this angle it hears the sound at its normal volume. **angleout** specifies the outside angle. When the listener is outside this the volume is indicated with **voloutside**. To be precise, **voloutside** is a negative number that indicates the number of hundreds of decibel that must be subtracted from the inside volume. Between the inside and outside angle the volume gradually decreases.

CD music

This functionality is only available in the Standard Edition of GameMaker.

There are also a number of functions dealing with playing music from a CD.

cd_init() Must be called before using the other functions. Should also be called when a CD is changed (or simply from time to time).

cd_present() Returns whether a CD is present in the default CD drive.

cd_number() Returns the number of tracks on the CD.

cd_playing() Returns whether the CD is playing.

cd_paused() Returns whether the CD is paused or stopped.

cd_track() Returns the number of the current track (1=the first).

cd_length() Returns the length of the total CD in milliseconds.

cd_track_length(n) Returns the length of track n of the CD in milliseconds.

cd_position() Returns the current position on the CD in milliseconds.

cd_track_position() Returns the current position in the track being played in milliseconds.

cd_play(first,last) Tells the CD to play tracks first until last. If you want to play the full CD give 1 and 1000 as arguments.

cd_stop() Stops playing.

cd_pause() Pauses the playing.

cd_resume() Resumes the playing.

cd_set_position(pos) Sets the position on the CD in milliseconds.

cd_set_track_position(pos) Sets the position in the current track in milliseconds.

cd_open_door() Opens the door of the CD player.

cd_close_door() Closes the door of the CD player.

There is one very general function to access the multimedia functionality of windows.

MCI_command(str) This function sends the command string to the Windows multimedia system using the Media Control Interface (MCI). It returns the return string. You can use this to control all sorts of multimedia devices. See the Windows documentation for information in how to use this command. For example `MCI_command('play cdaudio from 1')` plays a CD (after you have correctly initialized it using other commands). This function is only for advanced use!

Schermate iniziali, classifiche e altri pop-ups

In questa sezione descriveremo alcune funzioni che possono essere usate per mostrare delle schermate (splash screens) con video, immagini, ecc., per mostrare messaggi e chiedere qualcosa al giocatore, e mostrare la lista dei punteggi (highscore list/table).

Le informazioni sulle splash screens e sui messaggi si trovano in queste pagine:

[Splash Screens](#)

[Messaggi popup e domande](#)

[Highscore List](#)

Splash Screens

This functionality is only available in the Standard Edition of GameMaker.

Many games have so-called splash screens. These screens show a video, an image, or some text. Often they are used at the beginning of the game (as an intro), the beginning of a level, or at the end of the game (for example the credits). In *GameMaker* such splash screens with text, images or video can be shown at any moment during the game.

Default these splash screens are shown inside the game window, but it is also possible to show them in a separate window. The game is interrupted while the splash screen is shown. The player can return to the game by pressing the escape key or by clicking with the mouse in the window. (These settings can be changed; see below.)

The following functions can be used to display the splash screens:

splash_show_video(fname,loop) Shows a video splash screen. fname is the name of the video file.

Whether a particular movie file is supported depends on the drivers on the machine. Typically you can use .avi, .mpg, and .wmv files but avoid special codecs. You best put this file in the folder of the game yourself or in a subfolder. loop indicates whether to loop the video.

splash_show_text(fname,delay) Shows a text splash screen. fname is the name of the text file. You can either display standard text files (.txt) or rich text files (.rtf). Only part of the rich text features are taken into account. E.g. images and other embedded objects are not shown. delay indicates the delay in milliseconds before returning to the game. use 0 or a negative value to wait until the player presses the escape key or clicks with the mouse in the window. (Note that no scrollbar will be shown nor is there another way to scroll the text. So the text must fit the window.)

splash_show_image(fname,delay) Shows an image splash screen. fname is the name of the image file. Many image types are supported (for example .bmp, .jpg, .tif, and .wmf) but no animated images. delay is the delay in milli seconds before returning to the game.

splash_show_web(url,delay) Shows a web page splash screen. url is the url of the webpage (starting with http://) or it is the file name for a local html file. Note however that you must provide the full path for this to work. So you best e.g. use as url something like `working_directory + "\index.html"`. delay is the delay in milli seconds before returning to the game.

You can change the way the splash screens are displayed using the functions below:

splash_set_main(main) Indicated whether the splash screen must be shown in the main game window (true, default) or in a separate window (false).

splash_set_scale(scale) Sets the scale factor to be used when displaying a splash video or image. When using a value of 0 the scale factor is chosen such that the window is filled (default).

splash_set_cursor(vis) Sets whether the cursor should be visible in the splash screen. Default it is visible. For movies the cursor cannot be switched off.

splash_set_color(col) Sets the color of the area surrounding the image or video.

splash_set_caption(cap) Sets the caption for the splash window. This only has effect when is a separate splash window is used. Default the empty string is used.

splash_set_fullscreen(full) Indicates whether to use a full screen window or not. This only has effect when is a separate splash window is used. Default a normal window is used.

splash_set_border(border) Indicates whether the window should have a border. This only has effect when is a separate normal splash window is used. Default a border is used.

splash_set_size(w,h) Sets the size of the splash window. This only has effect when is a separate normal splash window is used. Default size is 640x480.

splash_set_position(x,y) Sets the position of the splash window. This only has effect when is a separate normal splash window is used. Default Windows determines the position.

splash_set_adapt(adapt) Indicated whether the size of the window must be adapted to the scaled size of the video or image. This only has effect when is a separate splash window is used. Default adapt is true.

splash_set_top(top) Indicates whether the window should stay on top of other windows. This only has effect when is a separate splash window is used. Default the value is true.

splash_set_interrupt(interrupt) Indicates whether the game play should be interrupted while showing

the splash window. This only has effect when a separate splash window is used. Default the value is true.

splash_set_stop_key(stop) Indicates whether to stop the display of the splash screen when the player pressed the Escape key. Default the value is true.

splash_set_stop_mouse(stop) Indicates whether to stop the display of the splash screen when the player pressed the mouse inside the splash screen. Default the value is true.

splash_set_close_button(show) Indicates whether to show a close button in the top right corner of the splash screen. This is useful when running games in full screen mode or without a border. Default the value is true.

There is one particular type of splash info, which is the game information that the user can enter in *GameMaker*. You can display it using the following function. You can also load a separate info file. This is closely related to the displaying of the text splash screen but the display is governed by the settings provided when defining the game information and not by the settings above. It is also displayed in a different window, so it is possible to display both the game information and a splash screen at the same moment. These functions also work in the Lite Edition.

show_info() Displays the game information window.

load_info(fname) Loads the game information from the file named fname. This should be a rich text file (.rtf). This makes it possible to show different help files at different moments. Note that contrary to the splash screens, this rtf file cannot contain images.

Messaggi popup e domande

Esistono alcune funzioni per mostrare messaggi, domande, menu con scelte, o una finestra in cui il giocatore può inserire un numero, una stringa, o indicare un colore o il nome di un file:

show_message(str) Mostra una finestra con una stringa come messaggio.

show_message_ext(str, but1, but2, but3) Mostra una finestra con una stringa come messaggio e fino a 3 bottoni. But1, but2 e but3 contengono il testo dei bottoni. Una stringa vuota indica che il bottone non verrà mostrato. Nelle stringhe puoi usare il simbolo & per indicare che il prossimo carattere dev'essere usato come scorciatoia da tastiera per questo bottone. La funzione restituisce il numero del bottone premuto (0 se il giocatore preme il tasto Esc).

show_question(str) Mostra una domanda; restituisce true quando il giocatore seleziona yes (sì), altrimenti false.

get_integer(str, def) Chiede un numero al giocatore. str è il messaggio, def il numero di default.

get_string(str, def) Chiede al giocatore una stringa. str è il messaggio, def la stringa default.

message_background(back) Imposta il background per le finestre pop-up di tutte le funzioni sopra. back dev'essere uno dei backgrounds definiti nel gioco. Sfortunatamente, i valori alpha non sono considerati. Comunque, se il pixel in basso a sinistra ha un valore alpha di 0, tutti i pixels con quel colore verranno considerati trasparenti.

message_alpha(alpha) Imposta la trasparenza per le finestre pop-up di tutte le funzioni sopra. alpha dev'essere un valore tra 0 (completamente trasparente) e 1 (non trasparente). Solo per Windows 2000 e successivi.

message_button(spr) Imposta lo sprite da usare per i bottoni nelle finestre pop-up. spr dev'essere uno sprite composto da 3 immagini: la prima indica il bottone quando non è premuto, il secondo quando il puntatore del mouse sta sopra al bottone, il terzo quando il bottone viene premuto. Sfortunatamente, i valori alpha non sono considerati, ma anche qui il pixel in basso a sinistra indica il colore trasparente.

message_text_font(name, size, color, style) Imposta la font per il testo nella finestra pop-up. (Questa è una normale font di Windows, non una delle risorse che puoi aggiungere nel gioco!) style indica lo stile della font (0=normale, 1=grassetto, 2=italico, 3=entrambi).

message_button_font(name, size, color, style) Imposta la font per i bottoni nelle finestre pop-up.

message_input_font(name, size, color, style) Imposta la font per le caselle di testo nei messaggi pop-up.

message_text_charset(type, charset) Questa funzione ti permette di cambiare il charset usato dalle finestre pop-up. type può essere uno di questi:

```
text_type
button_type
input_type
```

charset invece uno di questi:

```
ANSI_CHARSET
DEFAULT_CHARSET
EASTEUROPE_CHARSET
RUSSIAN_CHARSET
SYMBOL_CHARSET
SHIFTJIS_CHARSET
HANGEUL_CHARSET
GB2312_CHARSET
CHINESEBIG5_CHARSET
JOHAB_CHARSET
HEBREW_CHARSET
ARABIC_CHARSET
GREEK_CHARSET
TURKISH_CHARSET
VIETNAMESE_CHARSET
```

THAI_CHARSET
MAC_CHARSET
BALTIC_CHARSET
OEM_CHARSET

message_mouse_color(col) Imposta il colore della font per i bottoni nelle pop-up box quando il mouse Ã¨ sopra di loro.

message_input_color(col) Imposta il colore dello sfondo della casella di testo.

message_caption(show,str) Imposta la didascalia per le pop-up box. show indica se il bordo dev'essere mostrato (1) o no (0) e str indica la didascalia quando il bordo viene mostrato.

message_position(x,y) Imposta la posizione della finestra pop-up nello schermo. Usa -1, -1 per centrare la finestra.

message_size(w,h) Stabilisce la dimensione della finestra pop-up nello schermo. Se scegli -1 per la larghezza, verrÃ usata la larghezza dell'immagine. Se scegli -1 per l'altezza, l'altezza verrÃ calcolata in base al numero di linee del messaggio.

show_menu(str,def) Mostra un menu pop-up. str indica il testo del menu. Questo Ã¨ composto dai differenti elementi del menu con una barra verticale tra di essi. Per esempio, str = 'menu0|menu1|menu2'. Quando il primo elemento viene selezionato, la funzione restituisce 0, ecc. Quando il giocatore non seleziona niente, viene restituito def.

show_menu_pos(x,y,str,def) Mostra un menu pop-up come nella funzione precedente, ma in delle coordinate specifiche.

get_color(defcol) Chiede un colore al giocatore. defcol Ã¨ il colore di default. Se il giocatore preme Cancel/Annulla viene restituito -1.

get_open_filename(filter,fname) Chiede al giocatore il nome di un file da aprire specificando il filtro. Il filtro ha la forma 'nome1|mask1|nome2|mask2|...'. Una maschera contiene le differenti opzioni con un punto e virgola tra di essi. * significa qualunque stringa. Per esempio: 'Immagini bitmap|*.bmp;*.wmf'. Se l'utente preme Cancel/Annulla viene restituita una stringa vuota.

get_save_filename(filter,fname) Chiede al giocatore il nome di un file da salvare.

get_directory(dname) Chiede una directory (cartella). dname Ã¨ il nome di default. Se il giocatore preme Cancel/Annulla viene restituita una stringa vuota.

get_directory_alt(capt,root) Un modo alternativo per chiedere una directory. capt Ã¨ la didascalia da mostrare, la radice dell'albero da mostrare. Usa la stringa vuota per mostrare l'intero albero. Se l'utente preme Cancel/Annulla viene restituita una stringa vuota.

show_error(str,abort) Mostra un'errore standard (e/o lo scrive nel file log). abort indica se il gioco dev'essere abortito.

Highscore List

One special pop-up is the highscore list that is maintained for each game. The following functions exist:

highscore_show(numb) Shows the highscore table. *numb* is the new score. If this score is good enough to be added to the list, the player can input a name. Use -1 to simply display the current list.

highscore_set_background(back) Sets the background image to use. *back* must be the index of one of the background resources.

highscore_set_border(show) Sets whether the highscore form must have a border or not.

highscore_set_font(name,size,style) Sets the font used for the text in the table. (This is a normal Windows font, not one of the font resources.) You specify the name, size and style (0=normal, 1= bold, 2=italic, 3=bold-italic).

highscore_set_colors(back,new,other) Sets the colors used for the background, the new entry in the table, and the other entries.

highscore_set_strings(caption,nobody,escape) Changes the different default strings used when showing the highscore table. *caption* is the caption of the form. *nobody* is the string used when there is nobody at the particular rank. *escape* is the string at the bottom indicating to press the escape key. You can in particular use this when your game should use a different language.

highscore_show_ext(numb,back,border,col1,col2,name,size) Shows the highscore table with a number of options (can also be achieved by using a number of the previous functions). *numb* is the new score. If this score is good enough to be added to the list, the player can input a name. Use -1 to simply display the current list. *back* is the background image to use, *border* indicates whether or not to show the border. *col1* is the color for the new entry, *col2* the color for the other entries. *name* is the name of the font to use, and *size* is the font size.

highscore_clear() Clears the highscore list.

highscore_add(str,numb) Adds a player with name *str* and score *numb* to the list.

highscore_add_current() Adds the current score to the highscore list. The player is asked to provide a name.

highscore_value(place) Returns the score of the person on the given place (1-10). This can be used to draw your own highscore list.

highscore_name(place) Returns the name of the person on the given place (1-10).

draw_highscore(x1,y1,x2,y2) Draws the highscore table in the room in the indicated box, using the current font.

Risorse

In *GameMaker* you can define various types of resources, like sprites, sounds, fonts, objects, etc. In this chapter you will find a number of functions that give information about the resources. In the next chapter you find information on how to modify and create resources on the fly.

Information on resources can be found in the following pages:

[Sprites](#)

[Sounds](#)

[Backgrounds](#)

[Fonts](#)

[Paths](#)

[Scripts](#)

[Time lines](#)

[Objects](#)

[Rooms](#)

Sprites

The following functions will give you information about a sprite:

`sprite_exists(ind)` Returns whether a sprite with the given index exists.
`sprite_get_name(ind)` Returns the name of the sprite with the given index.
`sprite_get_number(ind)` Returns the number of subimages of the sprite with the given index.
`sprite_get_width(ind)` Returns the width of the sprite with the given index.
`sprite_get_height(ind)` Returns the height of the sprite with the given index.
`sprite_get_xoffset(ind)` Returns the x-offset of the sprite with the given index.
`sprite_get_yoffset(ind)` Returns the y-offset of the sprite with the given index.
`sprite_get_bbox_left(ind)` Returns the left side of the bounding box of the sprite with the given index.
`sprite_get_bbox_right(ind)` Returns the right side of the bounding box of the sprite with the given index.
`sprite_get_bbox_top(ind)` Returns the top side of the bounding box of the sprite with the given index.
`sprite_get_bbox_bottom(ind)` Returns the bottom side of the bounding box of the sprite with the given index.

In certain situations you might want to save the bitmap corresponding to a particular subimage of the sprite to a file. For this the following functions can be used:

`sprite_save(ind, subimg, fname)` Saves subimage subimg of sprite ind to the file with the name fname. This must be a .png file. ***Only available in the Standard Edition.***
`sprite_save_strip(ind, fname)` Saves all subimages of sprite ind as a strip to the file with the name fname. This must be a .png file. ***Only available in the Standard Edition.***

Suoni

Le seguenti funzioni vi forniranno informazioni sui suoni:

sound_exists(ind) Restituisce se esiste un suono con il dato indice.

sound_get_name(ind) Restituisce il nome del suono con il dato indice.

sound_get_kind(ind) Restituisce il tipo di suono con il dato indice (0=normale, 1=sottofondo, 2=3d, 3=mmplayer).

sound_get_preload(ind) Restituisce se il suono con il dato indice ha una impostazione di precaricamento.

I suoni usano molte risorse e molti sistemi possono immagazzinare e suonarne solo un numero limitato. Se progettate un gioco con molte caratteristiche vorrete avere maggiore controllo su quei suoni che sono caricati nella memoria audio nel tempo scelto. Potete scegliere di switchare su spento l'opzione di precaricamento per essere certi che i suoni vengano caricati solo quando devono essere usati. Ciò presenta il problema che potreste ottenere un piccolo effetto singhiozzo all'inizio dell'esecuzione dell'audio. L'audio altrettanto non viene automaticamente rilasciato quando non ne avete più bisogno. Per maggiore controllo potete usare le seguenti funzioni.

sound_discard(index) Libera la memoria audio usata per il suono indicato.

sound_restore(index) Ripristina il suono indicato nella memoria audio per una immediata esecuzione.

Backgrounds

The following functions will give you information about a background:

background_exists(ind) Returns whether a background with the given index exists.

background_get_name(ind) Returns the name of the background with the given index.

background_get_width(ind) Returns the width of the background with the given index.

background_get_height(ind) Returns the height of the background with the given index.

In certain situations you might want to save the bitmap corresponding the background to a file. For this the following function can be used:

background_save(ind, fname) Saves the background ind to the file with the name fname. This must be a .png file. ***Only available in the Standard Edition.***

Fonts

The following functions will give you information about a font:

font_exists(ind) Returns whether a font with the given index exists.

font_get_name(ind) Returns the name of the font with the given index.

font_get_fontname(ind) Returns the fontname of the font with the given index.

font_get_bold(ind) Returns whether the font with the given index is bold.

font_get_italic(ind) Returns whether the font with the given index is italic.

font_get_first(ind) Returns the index of the first character in the font with the given index.

font_get_last(ind) Returns the index of the last character in the font with the given index.

Paths

The following functions will give you information about a path:

path_exists(ind) Returns whether a path with the given index exists.

path_get_name(ind) Returns the name of the path with the given index.

path_get_length(ind) Returns the length of the path with the given index.

path_get_kind(ind) Returns the kind of connections of the path with the given index (0=straight, 1=smooth).

path_get_closed(ind) Returns whether the path is closed or not.

path_get_precision(ind) Returns the precision used for creating smoothed paths.

path_get_number(ind) Returns the number of defining points for the path.

path_get_point_x(ind,n) Returns the x-coordinate of the n'th defining point for the path. 0 is the first point.

path_get_point_y(ind,n) Returns the y-coordinate of the n'th defining point for the path. 0 is the first point.

path_get_point_speed(ind,n) Returns the speed factor at the n'th defining point for the path. 0 is the first point.

path_get_x(ind,pos) Returns the x-coordinate at position pos for the path. pos must lie between 0 and 1.

path_get_y(ind,pos) Returns the y-coordinate at position pos for the path. pos must lie between 0 and 1.

path_get_speed(ind,pos) Returns the speed factor at position pos for the path. pos must lie between 0 and 1.

Scripts

The following functions will give you information about a script:

script_exists(ind) Returns whether a script with the given index exists.

script_get_name(ind) Returns the name of the script with the given index.

script_get_text(ind) Returns the text string of the script with the given index.

Time lines

The following functions will give you information about a timeline:

`timeline_exists(ind)` Returns whether a time line with the given index exists.

`timeline_get_name(ind)` Returns the name of the time line with the given index.

Objects

The following functions will give you information about an object:

object_exists(ind) Returns whether an object with the given index exists.

object_get_name(ind) Returns the name of the object with the given index.

object_get_sprite(ind) Returns the index of the default sprite of the object with the given index.

object_get_solid(ind) Returns whether the object with the given index is default solid.

object_get_visible(ind) Returns whether the object with the given index is default visible.

object_get_depth(ind) Returns the depth of the object with the given index.

object_get_persistent(ind) Returns whether the object with the given index is persistent.

object_get_mask(ind) Returns the index of the mask of the object with the given index (-1 if it has no special mask).

object_get_parent(ind) Returns index of the parent object of object ind (a negative value is returned if it has no parent).

object_is_ancestor(ind1,ind2) Returns whether object ind2 is an ancestor of object ind1.

Rooms

The following functions will give you information about a room:

room_exists(ind) Returns whether a room with the given index exists.

room_get_name(ind) Returns the name of the room with the given index.

Note that, because rooms change during the playing of the game, there are other routines to get information about the contents of the current room.

Changing resources

This functionality is only available in the Standard Edition of GameMaker.

It is possible to create new resources during the game. Also you can change existing resources. This chapter describes the possibilities. Be warned though. **Changing resources easily leads to serious errors in your games!!!** You must follow the following rules when changing resources:

- Don't change resources that are being used. This will lead to errors! For example, don't change a sprite that is being used by an instance.
- When you save the game during playing, added and changed resources are NOT stored with the save game. So if you load the saved game later, these might not be there anymore. In general, when you manipulate resources you can no longer use the built-in system for loading and saving games.
- When you restart the game during playing, the changed resources are NOT restored to their original shape. In general, when you manipulate resources you can no longer use the action or function to restart the game.
- Resource manipulation can be slow. For example, changing sprites or backgrounds is relatively slow. So don't use it during the game play.
- Creating resources during game play (in particular sprites and background) easily uses huge amount of memory. So be extremely careful with this. For example, if you have a 32 frame 128x128 animated sprite and you decide to create 36 rotated copies of it you will use up $36 \times 32 \times 128 \times 128 \times 4 = 72$ MB of memory!
- Make sure you delete resources you no longer need. Otherwise the system soon runs out of memory.

In general, you should not change any resources during game play. Better create and change the resources at the beginning of the game or maybe at the beginning of a room.

Information on changing resources can be found in the following pages:

[Sprites](#)

[Sounds](#)

[Backgrounds](#)

[Fonts](#)

[Paths](#)

[Scripts](#)

[Time lines](#)

[Objects](#)

[Rooms](#)

Sprites

The following routines are available for changing sprite properties:

sprite_set_offset(ind,xoff,yoff) Sets the offset of the sprite with the given index.

The following routines can be used to create new sprites and to remove them.

sprite_duplicate(ind) Creates a duplicate of the sprite with the given index. It returns the index of the new sprite. When an error occurs -1 is returned.

sprite_assign(ind,spr) Assigns the indicated sprite to sprite ind. So this makes a copy of the sprite. In this way you can easily set an existing sprite to a different, e.g. new sprite.

sprite_merge(ind1,ind2) Merges the images from sprite ind2 into sprite ind1, adding them at the end. If the sizes don't match the sprites are stretched to fit. Sprite ind2 is not deleted!

sprite_add(fname,imgnumb,removeback,smooth,xorig,yorig) Adds the image stored in the file fname to the set of sprite resources. Many different image file types can be dealt with. When the image is not a gif image it can be a strip containing a number of subimages for the sprite next to each other. Use imgnumb to indicate their number (1 for a single image). For gif images, this argument is not used; the number of images in the gif file is used instead. *removeback* indicates whether to make all pixels with the background color (left-bottom pixel) transparent. *smooth* indicates whether to smooth the edges. *xorig* and *yorig* indicate the position of the origin in the sprite. The function returns the index of the new sprite that you can then use to draw it or to assign it to the variable *sprite_index* of an instance. When an error occurs -1 is returned.

sprite_replace(ind,fname,imgnumb,removeback,smooth,xorig,yorig) Same as above but in this case the sprite with index ind is replaced. The function returns whether it is successful.

sprite_add_sprite(fname) Adds the sprite stored the file fname to the set of sprite resources. The file must be a .gmspr file that is saved in the sprite property form in *GameMaker*. As this file contains all sprite settings, no further arguments are required. The function returns the index of the new sprite that you can then use to draw it or to assign it to the variable *sprite_index* of an instance. When an error occurs -1 is returned.

sprite_replace_sprite(ind,fname) Same as above but in this case the sprite with index ind is replaced. The function returns whether it is successful.

sprite_create_from_screen(x,y,w,h,removeback,smooth,xorig,yorig) Creates a sprite by copying the given area from the screen. *removeback* indicates whether to make all pixels with the background color (left-bottom pixel) transparent. *smooth* indicates whether to smooth the boundaries. This makes it possible to create any sprite you want. Draw the image on the screen using the drawing functions and next create a sprite from it. (If you don't do this in the drawing event you can even do it in such a way that it is not visible on the screen by not refreshing the screen.) The other parameters are as above. The function returns the index of the new sprite. A work of caution is required here. Even though we speak about the screen, it is actually the drawing region that matters. The fact that there is a window on the screen and that the image might be scaled in this window does not matter.

sprite_add_from_screen(ind,x,y,w,h,removeback,smooth) Adds an area of the screen as a next subimage to the sprite with index ind.

sprite_create_from_surface(id,x,y,w,h,removeback,smooth,xorig,yorig) Creates a sprite by copying the given area from the surface with the given id. *removeback* indicates whether to make all pixels with the background color (left-bottom pixel) transparent. *smooth* indicates whether to smooth the boundaries. This makes it possible to create any sprite you want. Draw the image on the surface using the drawing functions and next create a sprite from it. The function returns the index of the new sprite. Note that alpha values are maintained in the sprite.

sprite_add_from_surface(ind,id,x,y,w,h,removeback,smooth) Adds an area of the surface id as a next subimage to the sprite with index ind.

sprite_delete(ind) Deletes the sprite from memory, freeing the memory used.

The following routine exists to change the appearance of a sprite.

sprite_set_alpha_from_sprite(ind,spr) Changes the alpha (transparency) values in the sprite with index ind using the intensity values in the sprite spr. This cannot be undone.

Finally, you can change the collision checking mask for the sprite with the following routine. Please realize that this does not work correctly when an instance with that sprite is already present in the room.

```
sprite_collision_mask(ind,sepmasks,bboxmode,bbleft,bbttop,bbright,bbbottm,kind,tolerance)
```

Changes the collision mask for the sprite with index `ind`. `sepmasks` indicates whether there must be separate collision masks for all subimages. `bboxmode` is the bounding box mode (0=automatic, 1=full image, 2=user defined). `bbleft`, `bbright`, `bbtop`, `bbbottm` indicate the bounding box in case of user defined bounding box. You can use 0 for all these values in the other cases. `kind` is the kind of mask (0=precise, 1=bounding box, 2=disk, 3=diamond). `tolerance` indicates the tolerance in the transparency value (0=no tolerance, 255=full tolerance).

Sounds

The following routines can be used to create new sounds and to remove them.

sound_add(fname,kind,preload) Adds a sound resource to the game. fname is the name of the sound file. kind indicates the kind of sound (0=normal, 1=background, 2=3d, 3=mmplayer) preload indicates whether the sound should immediately be stored in audio memory (true or false). The function returns the index of the new sound, which can be used to play the sound. (-1 if an error occurred, e.g. the file does not exist).

sound_replace(index,fname,kind,preload) Same as the previous function but this time a new sound is not created but the existing sound index is replaced, freeing the old sound. Returns whether correct.

sound_delete(index) Deletes the indicated sound, freeing all memory associated with it. It can no longer be restored.

Backgrounds

Le seguenti funzioni possono essere usate per creare background e rimuoverli.

background_duplicate(ind) Crea un duplicato dello sfondo con il dato indice. Restituisce l'indice del nuovo sfondo. Se capita un'errore viene restituito -1.

background_assign(ind,back) Assegna lo sfondo indicato al dato indice. Così si fa una copia dello sfondo.

background_add(fname,removeback,smooth) Aggiunge l'immagine contenuta nel file fname nel set delle risorse degli sfondi. Possono essere usati vari tipi di immagini con questa funzione. Quando l'immagine possiede il canale alpha, questa viene usata per la trasparenza. *removeback* indica se rendere trasparenti tutti i pixel uguali al colore di sfondo (il pixel in basso a sinistra) *smooth* indica se i margini devono essere smussati. La funzione restituisce l'indice del nuovo sfondo che può essere usato per disegnarlo o assegnarlo alla variabile `background_index[0]` per visualizzarlo nella room corrente. In caso di errore viene restituito -1.

background_replace(ind,fname,removeback,smooth) Come la precedente funzione solo che in questo caso lo sfondo con il dato indice viene sovrascritto. Questa funzione restituisce se ha avuto successo. Quando lo sfondo attualmente visibile nella room viene rimpiazzato lo stesso.

background_add_background(fname) Aggiunge lo sfondo contenuto nel file fname nel set delle risorse degli sfondi. Questo file deve avere l'estensione .gmbck che è stato salvato tramite la finestra di proprietà dello sfondo di *GameMaker*. Questo file contiene tutte le impostazioni dello sfondo quindi non sono necessari argomenti. La funzione restituisce l'indice del nuovo sfondo che può essere usato per disegnarlo o assegnarlo alla variabile `background_index[0]` per visualizzarlo nella room corrente. In caso di errore viene restituito -1.

background_replace_background(ind,fname) Come la precedente funzione solo che in questo caso lo sfondo con il dato indice viene sovrascritto. Questa funzione restituisce se ha avuto successo. Quando lo sfondo attualmente visibile nella room viene rimpiazzato lo stesso.

background_create_color(w,h,col) Crea uno sfondo indicando la grandezza ed il colore indicati. Restituisce l'indice nel nuovo sfondo. In caso di errore viene restituito -1.

background_create_gradient(w,h,col1,col2,kind) Crea uno sfondo con un gradiente e grandezza indicati. *col1* e *col2* indicano i due colori del gradiente. *kind* è un valore tra 0 e 5 che indica il tipo di gradiente: 0=orizzontale 1=verticale, 2= rettangolo, 3=ellisse, 4=doppio orizzontale, 5=doppio verticale. Restituisce l'indice nel nuovo sfondo. In caso di errore viene restituito -1.

background_create_from_screen(x,y,w,h,removeback,smooth) Crea uno sfondo copiando l'area indicata dello schermo. *removeback* indica se rendere trasparenti tutti i pixel uguali al colore di sfondo (il pixel in basso a sinistra) *smooth* indica se i margini devono essere smussati. Questa funzione dà la possibilità di creare qualunque immagine vogliate. Basta disegnare un'immagine nello schermo usando le funzioni di disegno e successivamente crea uno sfondo da questo. (Se non fai ciò nel draw event questo non sarà visualizzato sullo schermo senza riaggiornarlo) La funzione restituisce l'indice dello sfondo. Occorre fare attenzione quando la si usa. Va precisato che, sebbene parliamo dello schermo, di fatto ci si riferisce all'area di raffigurazione interessata. Il fatto che esista una finestra sullo schermo e che quella immagine deve essere scalata in questa finestra, non significa che essa sia coinvolta nella procedura.

background_create_from_surface(id,x,y,w,h,removeback,smooth) Crea uno sfondo copiandolo dall'area indicata della surface con il dato indice. *removeback* indica se rendere trasparenti tutti i pixel uguali al colore di sfondo (il pixel in basso a sinistra) *smooth* indica se i margini devono essere smussati. Questa funzione dà la possibilità di creare qualunque immagine vogliate. Basta disegnare un'immagine nella surface usando le funzioni di disegno e successivamente crea uno sfondo da questa. Notare che il canale alpha viene mantenuto nello sfondo.

background_delete(ind) Cancella lo sfondo dalla memoria, liberando la memoria usata per esso.

Esiste la seguente funzione per cambiare l'aspetto dell'immagine di sfondo.

background_set_alpha_from_background(ind,back) Cambia i valori di trasparenza dello sfondo con l'indice indicato usando i valori d'intensità dello sfondo *back*. Questa azione non può essere annullata.

Fonts

È possibile creare, rimpiazzare e cancellare font durante il gioco usando le seguenti funzioni. (Non rimpiazzare una font che è settata come la font attuale o almeno resettatela in seguito)

font_add(name,size,bold,italic,first,last) Aggiunge una nuova font e restituisce il suo indice, indicando il nome, la misura, se in grassetto o italico, e il primo e l'ultimo carattere che deve essere creato.

font_add_sprite(spr,first,prop,sep) Aggiunge una nuova font e restituisce il suo indice. La font è creata da uno sprite. Lo sprite dovrà contenere una sottoimmagine per ogni carattere. *first* indica l'indice del primo carattere nello sprite. Per esempio, usate `ord('0')` se il vostro sprite contiene solo i numeri. *prop* indica se la font è proporzionale. In una font proporzionale, per ogni carattere la larghezza del profilo esterno (bounding box) è usata come la larghezza del carattere. Infine, *sep* indica l'ammontare dello spazio bianco che deve separare i caratteri orizzontalmente. Un valore tipico deve risiedere tra 2 e 8, dipende dalla misura della font.

font_replace(ind,name,size,bold,italic,first,last) Sostituisce il font *ind* con un nuovo font indicando nome, misura(size), se deve essere in grassetto o italico, e se devono essere creati il primo e l'ultimo carattere.

font_replace_sprite(ind,spr,first,prop,sep) Sostituisce il font *ind* con una nuova font basata sullo sprite..

font_delete(ind) Cancella la font con il dato indice, liberando la memoria da essa occupata.

Paths

E' possibile creare dei path e aggiungere dei punti ad essi. Comunque non cambiate mai un path che "attualmente in uso da un'istanza. Questo puo' portare ad errori inaspettati. Esistono le seguenti funzioni per la modifica dei path:

path_set_kind(ind, val) Setta il tipo di connessioni delle curve del path con il dato indice (0= spigolose, 1 = morbide).

path_set_closed(ind, closed) Imposta se il path deve essere chiuso (true) o aperto(false).

path_set_precision(ind, prec) Imposta la precisione con la quale calcolare le curve morbide del path (dovr' essere tra 1 e 8)

path_add() Crea un nuovo path vuoto e ne restituisce l'indice.

path_delete(ind) Elimina il path con il dato indice.

path_duplicate(ind) Crea una copia del path indicato e ne restituisce l'indice.

path_assign(ind, path) Assegna il path all'indice indicato. Questo creer' una copia del path. In questo modo puoi impostare facilmente un path esistente in un'altro, per esempio uno nuovo.

path_append(ind, path) Aggiunge il path indicato al path con indice *ind*.

path_add_point(ind, x, y, speed) Aggiunge un punto al path con il dato indice alla posizione (x,y) e con la velocit' *speed* indicata. Ricordate che un valore di 100 corrisponde alla velocit' attuale. Valori pi' bassi faranno rallentare mentre valori pi' alti faranno accelerare.

path_insert_point(ind, n, x, y, speed) Inserisce un punto al path con il dato indice alla posizione (x,y) prima del punto n con la velocit' indicata.

path_change_point(ind, n, x, y, speed) Modifica il punto n nel path con il dato indice indicando posizione (x,y) e velocit'.

path_delete_point(ind, n) Elimina il punto n del path con il dato indice.

path_clear_points(ind) Elimina tutti i punti del path ottenendo un path vuoto.

path_reverse(ind) Inverte il path.

path_mirror(ind) Specchia il path orizzontalmente (rispetto al suo centro)

path_flip(ind) Specchia il path verticalmente (rispetto al suo centro)

path_rotate(ind, angle) Ruota il path in senso antiorario con l'angolo indicato in gradi (rispetto al suo centro)

path_scale(ind, xscale, yscale) Scala il path con i valori indicati (rispetto al suo centro)

path_shift(ind, xshift, yshift) Sposta il path con i valori indicati.

Scripts

Gli script non possono essere cambiati durante l'esecuzione del gioco. Gli script sono parte della logica del programma. Cambiare gli script condurrebbe alla autoriscrittura del codice che porterebbe facilmente ad errori. Ci sono altri sistemi per far fronte a questa necessità. Se avete veramente bisogno di eseguire un pezzo di codice che non è stato creato durante lo sviluppo (ad esempio, leggere il codice da un file) potete usare le seguenti funzioni:

execute_string(str, arg0, arg1, ...) Esegue il pezzo di codice contenuto nella stringa `str` con gli argomenti indicati.

execute_file(fname, arg0, arg1, ...) Esegue il pezzo di codice contenuto in un file con gli argomenti indicati.

A volte vorrete memorizzare l'indice di uno script in una variabile ed eseguirlo. Per fare ciò usate le seguenti funzioni:

script_execute(scr, arg0, arg1, ...) Esegue lo script con indice `scr` con gli argomenti indicati.

Time lines

Le seguenti funzioni sono disponibili per creare e modificare le time line. Non cambiate le time line mentre le state usando!

timeline_add() Crea una nuova time line e ne restituisce l'indice.

timeline_delete(ind) Elimina la time line con il dato indice. Assicuratevi di non avere istanze che la usano.

timeline_clear(ind) Pulisce la time line con il dato indice rimuovendo tutti i momenti. Assicuratevi di non avere istanze che usano la time line mentre usate questa funzione.

timeline_moment_add(ind,step,codestr) Aggiunge l'azione codice alla timeline nel momento step. codestr deve contenere il codice di questa azione. Se lo step non esiste verrÃ creato. In questo modo puoi aggiungere varie azioni di codice nello stesso momento.

timeline_moment_clear(ind,step) Puoi usare questa funzione per pulire tutte le azioni di un particolare momento.

Objects

Anche gli oggetti possono essere manipolati durante la partita. NON cambiate o cancellate MAI un oggetto per il quale ci sono delle istanze. Questo può portare ad effetti inaspettati come certe proprietà dell'oggetto memorizzate con l'istanza e via dicendo, cambiandole nell'oggetto non si otterrà l'effetto desiderato.

object_set_sprite(ind,spr) Imposta lo sprite dell'oggetto con il dato indice. Usate -1 per rimuovere lo sprite attuale dall'oggetto.

object_set_solid(ind,solid) Imposta se le istanze create dell'oggetto devono essere solide di default (true o false)

object_set_visible(ind,vis) Imposta se le istanze create dell'oggetto devono essere visibili di default (true o false)

object_set_depth(ind,depth) Imposta la depth di default delle istanze create dell'oggetto.

object_set_persistent(ind,pers) Imposta se le istanze create dell'oggetto devono essere persistenti di default (true o false).

object_set_mask(ind,spr) Imposta la maschera dello sprite dell'oggetto con il dato indice. Usate -1 per impostare che la maschera sarà lo sprite dell'oggetto.

object_set_parent(ind,obj) Imposta il parent dell'oggetto. Usate -1 per non avere parent. Cambiare il parent cambia il comportamento delle istanze dell'oggetto.

Le seguenti funzioni sono utili per creare oggetti al volo. Come per tutte le altre funzioni per cambiare le risorse state attenti a non creare nuovi oggetti ogni volta.

object_add() Crea un nuovo oggetto e ne restituisce l'indice. Potete usare questo indice nelle funzioni qui sotto per impostare determinate proprietà dell'oggetto e per creare delle istanze.

object_delete(ind) Elimina l'oggetto con il dato indice. Assicuratevi di non avere istanze di questo oggetto attualmente esistenti.

object_event_add(ind,evtype,evnumb,codestr) Per cambiare il comportamento dell'oggetto bisogna definire degli eventi. A questi eventi si può aggiungere solo ed esclusivamente del codice. E' necessario specificare l'oggetto, il tipo di evento, il numero dell'evento(usate le costanti descritte prima della funzione event_perform()) ed infine la stringa contenente il codice che deve essere eseguito. Potete aggiungere più pezzi di codice per ogni evento.

object_event_clear(ind,evtype,evnumb) Usate questa funzione per eliminare tutte le azioni di un particolare evento.

Creare oggetti è particolarmente utile quando state progettando degli script o delle librerie di azioni. Per esempio, uno script di inizializzazione può creare un oggetto che mostri del testo e un altro script può aggiungerlo ad un oggetto con un testo specifico. In questo modo avete un facile meccanismo per mostrare testi senza necessariamente creare oggetti che usino l'interfaccia standard.

Rooms

Manipulating rooms on the fly is a dangerous thing to do. You have to realize that rooms change all the time due to what is happening in the game. This normally only involves the currently active room and there are many routines described in previous sections to manipulate the instances, backgrounds, and tiles in the active room. But changes in the active room will last if the room is persistent. Hence, you should never manipulate aspects of the currently active room or any room that is persistent and that has already been visited before. Such changes in general won't be noticed but might sometimes even lead to unexpected errors. Due to the fact that rooms are linked in a complicated way there is also no routine to delete a room.

The following routines are available

room_set_width(ind,w) Sets the width for the room with the indicated index.

room_set_height(ind,h) Sets the height for the room with the indicated index.

room_set_caption(ind,str) Sets the caption for the room with the indicated index.

room_set_persistent(ind,val) Sets whether the room with the indicated index is persistent or not.

room_set_code(ind,str) Sets the initialization code string for the room with the indicated index.

room_set_background_color(ind,col,show) Sets the color properties for the room with the indicated index if it does not have a background image. col indicates the color and show indicates whether the color must be shown or not.

room_set_background(ind,bind,vis,fore,back,x,y,h tiled,v tiled,hspeed,vspeed,alpha) Sets background with index bind (0-7) for the room with the indicated index. vis indicates whether the background is visible and fore whether it is actually a foreground. back is the index of the background image. x,y indicate the position of the image and h tiled and v tiled indicate whether the image must be tiled. h speed and v speed indicate the speed with which the background moves and alpha indicates an alpha translucency value (1 = solid and fastest).

room_set_view(ind,vind,vis,xview,yview,wview,hview,xport,yport,wport,hport,hborder,vborder,hspeed,vspeed,obj) Sets the view with index vind (0-7) for the room with the indicated index. vis indicates whether the view is visible. xview, yview, wview, and hview indicate the position of the view in the room. xport, yport, wport, and hport indicate the position on the screen. When the view must follow an object hborder and vborder indicate the minimal visible border that must be kept around the object. h speed and v speed indicate the maximal speed with which the view can move. obj is the index of the object or the index of the instance.

room_set_view_enabled(ind,val) Sets whether views must be enabled for the room with the indicated index.

room_add() Adds a new room. It returns the index of the room. Note that the room will not be part of the room order. So the new room does not have a previous or a next room. If you want to move to an added room you must provide the index of the room.

room_duplicate(ind) Adds a copy of the room with the given index. It returns the index of the room.

room_assign(ind,room) Assigns the indicated room to room ind. So this makes a copy of the room.

room_instance_add(ind,x,y,obj) Adds a new instance of object obj to the room, placing it at the indicated position. It returns the index of the instance.

room_instance_clear(ind) Removes all instances from the indicated room.

room_tile_add(ind,back,left,top,width,height,x,y,depth) Adds a new tile to the room at the indicated position. It returns the index of the tile. back is the background from which the tile is taken. left, top, width and height indicate the part of the background that forms the tile. x,y is the position of the tile in the room and depth is the depth of the tile.

room_tile_add_ext(ind,back,left,top,width,height,x,y,depth,xscale,yscale,alpha) Same as the previous routine but this time you can also specify a scaling factor in x and y direction and an alpha transparency for the tile.

room_tile_clear(ind) Removes all tiles from the indicated room.

Files, registro, esecuzione programmi e device specifico

Nei giochi più¹ avanzati probabilmente vorrai leggere dati da un file allegato con il gioco. O potresti volere immagazzinare informazioni mentre il gioco è² in esecuzione. Oppure in alcune situazioni potresti aver bisogno di eseguire programmi esterni.

Le informazioni riguardo ci² possono essere trovate nelle seguenti pagine:

[File](#)

[Registri](#)

[File INI](#)

[Esecuzione di programmi](#)

[Comandi specifici del dispositivo](#)

File

It is useful to use external files in games. For example, you could make a file that describes at what moments certain things should happen. Also you probably want to save information for the next time the game is run (for example, the current room). The following functions exist to read and write data in text files:

file_text_open_read(fname) Opens the file with the indicated name for reading. The function returns the id of the file that must be used in the other functions. You can open multiple files at the same time (32 max). Don't forget to close them once you are finished with them.

file_text_open_write(fname) Opens the indicated file for writing, creating it if it does not exist. The function returns the id of the file that must be used in the other functions.

file_text_open_append(fname) Opens the indicated file for appending data at the end, creating it if it does not exist. The function returns the id of the file that must be used in the other functions.

file_text_close(fileid) Closes the file with the given file id.

file_text_write_string(fileid, str) Writes the string to the file with the given file id.

file_text_write_real(fileid, x) Write the real value to the file with the given file id. (As separator between the integer and decimal part always a dot is used.

file_text_writeln(fileid) Write a newline character to the file.

file_text_read_string(fileid) Reads a string from the file with the given file id and returns this string. A string ends at the end of line.

file_text_read_real(fileid) Reads a real value from the file and returns this value.

file_text_readln(fileid) Skips the rest of the line in the file and starts at the start of the next line.

file_text_eof(fileid) Returns whether we reached the end of the file.

file_text_eoln(fileid) Returns whether we reached the end of a line in the file.

To manipulate files in the file system you can use the following functions:

file_exists(fname) Returns whether the file with the given name exists (true) or not (false).

file_delete(fname) Deletes the file with the given name.

file_rename(oldname, newname) Renames the file with name oldname into newname.

file_copy(fname, newname) Copies the file fname to the newname.

directory_exists(dname) Returns whether the indicated directory does exist. The name must include the full path, not a relative path.

directory_create(dname) Creates a directory with the given name (including the path towards it) if it does not exist. The name must include the full path, not a relative path.

file_find_first(mask, attr) Returns the name of the first file that satisfies the mask and the attributes. If no such file exists, the empty string is returned. The mask can contain a path and can contain wildchars, for example 'C:\temp*.doc'. The attributes give the additional files you want to see. (So the normal files are always returned when they satisfy the mask.) You can add up the following constants to see the type of files you want:

fa_readonly read-only files

fa_hidden hidden files

fa_sysfile system files

fa_volumeid volume-id files

fa_directory directories

fa_archive archived files

file_find_next() Returns the name of the next file that satisfies the previously given mask and the attributes. If no such file exists, the empty string is returned.

file_find_close() Must be called after handling all files to free memory.

file_attributes(fname, attr) Returns whether the file has all the attributes given in attr. Use a combination of the constants indicated above.

The following functions can be used to change file names. Note that these functions do not work on the actual files they only deal with the strings.

filename_name(fname) Returns the name part of the indicated file name, with the extension but without the path.

filename_path(fname) Returns the path part of the indicated file name, including the final backslash.

filename_dir(fname) Returns the directory part of the indicated file name, which normally is the same as the path except for the final backslash.

filename_drive(fname) Returns the drive information of the filename.

filename_ext(fname) Returns the extension part of the indicated file name, including the leading dot.

filename_change_ext(fname,newext) Returns the indicated file name, with the extension (including the dot) changed to the new extension. By using an empty string as the new extension you can remove the extension.

In rare situations you might need to read data from binary files. The following low-level routines exist for this:

file_bin_open(fname,mod) Opens the file with the indicated name. The mode indicates what can be done with the file: 0 = reading, 1 = writing, 2 = both reading and writing). When the file does not exist it is created. The function returns the id of the file that must be used in the other functions. You can open multiple files at the same time (32 max). Don't forget to close them once you are finished with them.

file_bin_rewrite(fileid) Rewrites the file with the given file id, that is, clears it and starts writing at the start.

file_bin_close(fileid) Closes the file with the given file id.

file_bin_size(fileid) Returns the size (in bytes) of the file with the given file id.

file_bin_position(fileid) Returns the current position (in bytes; 0 is the first position) of the file with the given file id.

file_bin_seek(fileid,pos) Moves the current position of the file to the indicated position. To append to a file move the position to the size of the file before writing.

file_bin_write_byte(fileid,byte) Writes a byte of data to the file with the given file id.

file_bin_read_byte(fileid) Reads a byte of data from the file and returns this.

If the player has checked secure mode in his preferences, for a number of these routines, you are not allowed to specify a path, and only files in the application folder can e.g. be written.

If you included files in the game executable and did not automatically export them at the start of the game, you can use the following functions to do this.

export_include_file(fname) Exports the included file with the name fname. This must be a string variable, so don't forget the quotes.

export_include_file_location(fname,location) Exports the included file with the name fname to the given location. Location must contain the path and the filename.

discard_include_file(fname) Discard the included file with the name fname, freeing the memory used. This must be a string variable, so don't forget the quotes.

The following four read-only variables can be useful:

game_id* Unique identifier for the game. You can use this if you need a unique file name.

working_directory* Working directory for the game. (Not including the final backslash.)

program_directory* Directory in which the game executable is stored. (Not including the final backslash.) When you run a standalone game this is normally the same as the working directory unless the game e.g. opens a file using the file selector. Note that when testing a game you are creating the program and working directory will be different. In that case the working directory is the place where the editable version is stored while the program directory is a temporary directory for testing.

temp_directory* Temporary directory created for the game. (Not including the final backslash.) You can store temporary files here. They will be removed at the end of the game.

In certain situations you might want to give players the possibility of providing command line arguments to the game they are running (for example to create cheats or special modes). To get these arguments you can use the following two routines.

parameter_count() Returns the number of command-line parameters. The actual parameters can be retrieved with the following function.

parameter_string(n) Returns command-line parameters n. The first parameter has index 1. The last one has index **parameter_count()**. Index 0 is a special one. It is the filename of the game executable (including the path).

You can read the value of environment variables using the following function:

environment_get_variable(name) Returns the value (a string) of the environment variable with the given name.

Finally, if you are interested in the size of the disk and the free space, you can use the following functions:

disk_size(drive) Returns the size of the indicated drive in bytes. *drive* must be a capital letter, e.g. 'C'. If you do not provide the drive, the drive of the current working directory is used.

disk_free(drive) Returns the amount of free space on the indicated drive in bytes. *drive* must be a capital letter, e.g. 'C'. If you do not provide the drive, the drive of the current working directory is used.

Registri

If you want to store a small amount of information between runs of the game there is a simpler mechanism than using a file. You can use the registry. The registry is a large database that Windows maintains to keep track of all sorts of settings for programs. An entry has a name, and a value. You can use both string and real values. The following functions exist:

registry_write_string(name, str) Creates an entry in the registry with the given name and string value.

registry_write_real(name, x) Creates an entry in the registry with the given name and real value.

registry_read_string(name) Returns the string that the given name holds. (The name must exist. Otherwise an empty string is returned.)

registry_read_real(name) Returns the real value that the given name holds. (The name must exist. Otherwise the number 0 is returned.)

registry_exists(name) Returns whether the given name exists.

Actually, values in the registry are grouped into keys. The above routines all work on values within the key that is especially created for your game. Your program can use this to obtain certain information about the system the game is running on. You can also read values in other keys. You can write them also but be very careful. YOU CAN EASILY DESTROY YOUR SYSTEM this way. (Write is not allowed in secure mode.) Note that keys are again placed in groups. The following routines default work on the group HKEY_CURRENT_USER. But you can change the root group. So, for example, if you want to find out the current temp dir, use

```
path = registry_read_string_ext('\Environment', 'TEMP');
```

The following functions exist:

registry_write_string_ext(key, name, str) Creates an entry in the key in the registry with the given name and string value.

registry_write_real_ext(key, name, x) Creates an entry in the key in the registry with the given name and real value.

registry_read_string_ext(key, name) Returns the string that the given name in the indicated key holds. (The name must exist. Otherwise an empty string is returned.)

registry_read_real_ext(key, name) Returns the real value that the given name in the indicated key holds. (The name must exist. Otherwise the number 0 is returned.)

registry_exists_ext(key, name) Returns whether the given name exists in the given key.

registry_set_root(root) Sets the root for the other routines. Use the following values:

0 = HKEY_CURRENT_USER

1 = HKEY_LOCAL_MACHINE

2 = HKEY_CLASSES_ROOT

3 = HKEY_USERS

INI files

To pass certain parameter settings to programs a standard mechanism is the use of INI files. INI files contain sections and each section contains a number of name-value pairs. For example, here is a typical INI file:

```
[Form]
Top=100
Left=100
Caption=The best game ever
[Game]
MaxScore=12324
```

This file contains two sections, one called Form and the other called Game. The first section contains three pairs. The first two have a real value while the third has a string value. Such INI files are easy to create and change. The following functions exist in *GameMaker* to read and change the data in them.

ini_open(name) Opens the INI file with the given name. The ini file must be stored in the same folder as the game!

ini_close() Closes the currently open INI file.

ini_read_string(section,key,default) Reads the string value of the indicated key in the indicated section. When the key or section does not exist the default value is returned.

ini_read_real(section,key,default) Reads the real value of the indicated key in the indicated section. When the key or section does not exist the default value is returned.

ini_write_string(section,key,value) Writes the string value for the indicated key in the indicated section.

ini_write_real(section,key,value) Writes the real value for the indicated key in the indicated section.

ini_key_exists(section,key) Returns whether the indicated key exists in the indicated section.

ini_section_exists(section) Returns whether the indicated section exists.

ini_key_delete(section,key) Deletes the indicated key from the indicated section.

ini_section_delete(section) Deletes the indicated section.

Esecuzione di programmi

GameMaker also has the possibility to start external programs. There are two functions available for this: `execute_program` and `execute_shell`. The function `execute_program` starts a program, possibly with some arguments. It can wait for the program to finish (pausing the game) or continue the game. The function `execute_shell` opens a file. This can be any file for which some association is defined, e.g. an html-file, a word file, etc. Or it can be a program. It cannot wait for completion so the game will continue.

`execute_program(prog, arg, wait)` Executes program `prog` with arguments `arg`. `wait` indicates whether to wait for finishing.

`execute_shell(prog, arg)` Executes the program (or file) in the shell.

Both functions will not work if the player sets the secure mode in the preferences. You can check this using the read-only variable:

`secure_mode*` Whether the game is running in secure mode.

Comandi specifici del dispositivo

GameMaker also has the possibility to start external programs. There are two functions available for this: `execute_program` and `execute_shell`. The function `execute_program` starts a program, possibly with some arguments. It can wait for the program to finish (pausing the game) or continue the game. The function `execute_shell` opens a file. This can be any file for which some association is defined, e.g. an html-file, a word file, etc. Or it can be a program. It cannot wait for completion so the game will continue.

os_type This variable holds the platform the game is running on. It can be one of the following:-

- `os_win32` Windows 32bit executable.
- `os_win64` Windows 64bit executable.
- `os_macosx` Mac OSX.
- `os_psp` Playstation portable.
- `os_ios` Apple iOS (iPhone, iPad, iPod Touch etc.)
- `os_android` Android device (phone or tablet)

os_device This variable helps to further classify the device your running on. It can be one of the following-

- `device_ios_iphone` iPhone non-retina.
- `device_ios_iphone_retina` An iPhone with a retina display.
- `device_ios_ipad` iPad device.

Strutture dati

This functionality is only available in the Standard Edition of GameMaker.

In games you often need to store information. For example you need to store lists of items that a person carries or you want to store places that still need to be visited. You can use the arrays for this. But if you want to do more complicated operations, like sorting the data or searching for a particular item, you need to write large pieces of GML code which can be slow to execute.

To remedy this, *GameMaker* has a number of built-in data structures that can be accessed through functions. At the moment there are six different types of data structure available: stacks, queues, lists, maps, priority queues, and grids. Each of these data structures is tuned for a particular type of use (see below).

All data structures work globally in the same way. You can create a data structure with a function that returns an id for the structures. You use this id to perform operations on the data structures. Once you are done you destroy the data structure again to save storage. You can use as many of the structures at the same moment as you want. All structure can store both strings and real values.

Please note that data structures and their content are not saved when you save the game using the actions or functions for that. If you use data structures and want to allow for saves you have to create your own mechanism for that.

When comparing values, for example when searching in a map or sorting a list, *GameMaker* must decide when two values are equal. For strings and integer values this is clear but for real numbers, due to round-off errors, equal number can easily become unequal. For example $(5/3)*3$ will not be equal to 5. To avoid this, a precision is used. When the difference between two numbers is smaller than this precision they are considered equal. Default a precision of 0.0000001 is used. You can change this precision using the following function:

`ds_set_precision(prec)` Sets the precision used for comparisons.

This precision is used in all data structures but not in other comparisons in GML!

Information on data structures can be found in the following pages:

[Stacks](#)

[Queues](#)

[Lists](#)

[Maps](#)

[Priority Queues](#)

[Grids](#)

Stacks

A stack data structure is a so called LIFO (Last-In First-Out) structures. You can push values on a stack and then remove them again by popping them from the stack. The value that was pushed on the stack most recently is the first to be popped from it again. Stacks are often used when there are interrupts to handle, or when having recursive functions. The following functions exist for stacks:

ds_stack_create() Creates a new stack. The function returns an integer as an id that must be used in all other functions to access the particular stack. You can create multiple stacks.

ds_stack_destroy(id) Destroys the stack with the given id, freeing the memory used. Don't forget to call this function when you are ready with the structure.

ds_stack_clear(id) Clears the stack with the given id, removing all data from it but not destroying it.

ds_stack_copy(id, source) Copies the stack source into the stack with the given id.

ds_stack_size(id) Returns the number of values stored in the stack.

ds_stack_empty(id) Returns whether the stack is empty. This is the same as testing whether the size is 0.

ds_stack_push(id, val) Pushes the value on the stack.

ds_stack_pop(id) Returns the value on the top of the stack and removes it from the stack.

ds_stack_top(id) Returns the value on the top of the stack but does not remove it from the stack.

ds_stack_write(id) Turns the data structure into a string and returns this string. The string can then be used to e.g. save it to a file. This provides an easy mechanism for saving data structures.

ds_stack_read(id, str) Reads the data structure from the given string (as created by the previous call).

Queues

A queue is somewhat similar to a stack but it works on a FIFO (First-In First-Out) basis. The value that is put in the queue first is also the first to be removed from it. It works like a queue in a shop. The person who is first in a queue is served first. Queues are typically used to store things that still need to be done but there are many other uses. The following functions exist (note that the first five are equivalent to the functions for stacks; all data structures have these five functions):

ds_queue_create() Creates a new queue. The function returns an integer as an id that must be used in all other functions to access the particular queue. You can create multiple queues.

ds_queue_destroy(id) Destroys the queue with the given id, freeing the memory used. Don't forget to call this function when you are ready with the structure.

ds_queue_clear(id) Clears the queue with the given id, removing all data from it but not destroying it.

ds_queue_copy(id, source) Copies the queue source into the queue with the given id.

ds_queue_size(id) Returns the number of values stored in the queue.

ds_queue_empty(id) Returns whether the queue is empty. This is the same as testing whether the size is 0.

ds_queue_enqueue(id, val) Enters the value in the queue.

ds_queue_dequeue(id) Returns the value that is longest in the queue and removes it from the queue.

ds_queue_head(id) Returns the value at the head of the queue, that is, the value that has been the longest in the queue. (It does not remove it from the queue.)

ds_queue_tail(id) Returns the value at the tail of the queue, that is, the value that has most recently been added to the queue. (It does not remove it from the queue.)

ds_queue_write(id) Turns the data structure into a string and returns this string. The string can then be used to e.g. save it to a file. This provides an easy mechanism for saving data structures.

ds_queue_read(id, str) Reads the data structure from the given string (as created by the previous call).

Lists

Una lista memorizza una collezione di valori in un particolare ordine. Puoi aggiungere valori alla fine o inserire qualcosa nel mezzo della lista. Puoi indirizzare i valori usando un indice. Puoi anche ordinare gli elementi, sia in ordine crescente o decrescente. Le liste possono essere usanti in molti modi, per esempio per memorizzare cambiamenti di collezioni di valori. Loro sono implementate usando semplici arrays ma, questo Ã fatto in codice compilato ed Ã piÃ veloce che usando un proprio array. Le seguenti funzioni sono disponibili:

ds_list_create() Crea una nuova lista. Le funzioni ritornano un intero come id che deve essere usato in tutte le altre funzioni per accedere a particolare liste.

ds_list_destroy(id) Distrugge la lista con dato id, liberando la memoria usata. Non dimenticarti di chiamare questa funzioni quando sei pronto con la struttura.

ds_list_clear(id) Pulisce la lista con dato id, rimuovendo tutti i dati da esso ma senza distruggerla.

ds_list_copy(id,source) Copia il sorgente della list nella lista con dato id.

ds_list_size(id) Ritorna il numero di valori memorizzati nella lista.

ds_list_empty(id) Ritorna quando la lista Ã vuota. Questo Ã lo stesso test quando la dimensione Ã 0.

ds_list_add(id,val) Aggiunge il valore alla fine della lista.

ds_list_insert(id,pos,val) Inserisce il valore alla posizione pos nella lista. La prima posizione Ã 0, l'ultima posizione Ã la dimensione della lista meno 1.

ds_list_replace(id,pos,val) Riposiziona il valore alla posizione pos nella lista con il nuovo valore.

ds_list_delete(id,pos) Cancella il valore alla posizione pos nella lista. (La posizione 0 Ã il primo elemento.)

ds_list_find_index(id,val) Cerca la posizione memorizzata al valore indicato. Se il valore non Ã nella lista -1 Ã ritornato.

ds_list_find_value(id,pos) Ritorna il valore memorizzato alla posizione indicata nella lista.

ds_list_sort(id,ascend) Ordina i valori nella lista. Quando ascend Ã true i valori sono ordinati in ordine crescente, altrimenti in ordine decrescente.

ds_list_shuffle(id) Mescola i valori nella lista in modo tale da finire in un ordine casuale.

ds_list_write(id) Trasforma la struttura dati in una stringa e la ritorna. La stringa puÃ essere usata, ad esempio, salvata in un file. Questo fornisce un facile meccanismo per il salvataggio delle strutture dati.

ds_list_read(id,str) Legge la struttura dati dalla stringa data (creata dalla precedente chiamata).

Maps

In quite a few situations you need to store pairs consisting of a key and a value. For example, a character can have a number of different items and for each item it has a particular number of those. In this case the item is the key and the number is the value. Maps maintain such pairs, sorted by key. You can add pairs to the map and search for the value corresponding to certain keys. Because the keys are sorted you can also find previous and next keys. Sometimes it is also useful to use a map to just store keys without a corresponding value. In that case you can simply use a value of 0. The following functions exist:

ds_map_create() Creates a new map. The function returns an integer as an id that must be used in all other functions to access the particular map.

ds_map_destroy(id) Destroys the map with the given id, freeing the memory used. Don't forget to call this function when you are ready with the structure.

ds_map_clear(id) Clears the map with the given id, removing all data from it but not destroying it.

ds_map_copy(id,source) Copies the map source into the map with the given id.

ds_map_size(id) Returns the number of key-value pairs stored in the map.

ds_map_empty(id) Returns whether the map is empty. This is the same as testing whether the size is 0.

ds_map_add(id,key,val) Adds the key-value pair to the map.

ds_map_replace(id,key,val) Replaces the value corresponding with the key with a new value.

ds_map_delete(id,key) Deletes the key and the corresponding value from the map. (If there are multiple entries with the same key, only one is removed.)

ds_map_exists(id,key) Returns whether the key exists in the map.

ds_map_find_value(id,key) Returns the value corresponding to the key.

ds_map_find_previous(id,key) Returns the largest key in the map smaller than the indicated key. (Note that the key is returned, not the value. You can use the previous routine to find the value.)

ds_map_find_next(id,key) Returns the smallest key in the map larger than the indicated key.

ds_map_find_first(id) Returns the smallest key in the map.

ds_map_find_last(id) Returns the largest key in the map.

ds_map_write(id) Turns the data structure into a string and returns this string. The string can then be used to e.g. save it to a file. This provides an easy mechanism for saving data structures.

ds_map_read(id,str) Reads the data structure from the given string (as created by the previous call).

Priority Queues

In a priority queue a number of values are stored, each with a priority. You can quickly find the values with minimum and maximum priority. Using this data structure you can handle certain things in the order of priority. The following functions exist:

ds_priority_create() Creates a new priority queue. The function returns an integer as an id that must be used in all other functions to access the particular priority queue.

ds_priority_destroy(id) Destroys the priority queue with the given id, freeing the memory used. Don't forget to call this function when you are ready with the structure.

ds_priority_clear(id) Clears the priority queue with the given id, removing all data from it but not destroying it.

ds_priority_copy(id,source) Copies the priority queue source into the priority queue with the given id.

ds_priority_size(id) Returns the number of values stored in the priority queue.

ds_priority_empty(id) Returns whether the priority queue is empty. This is the same as testing whether the size is 0.

ds_priority_add(id,val,prio) Adds the value with the given priority to the priority queue.

ds_priority_change_priority(id,val,prio) Changes the priority of the given value in the priority queue.

ds_priority_find_priority(id,val) Returns the priority of the given value in the priority queue.

ds_priority_delete_value(id,val) Deletes the given value (with its priority) from the priority queue.

ds_priority_delete_min(id) Returns the value with the smallest priority and deletes it from the priority queue.

ds_priority_find_min(id) Returns the value with the smallest priority but does not delete it from the priority queue.

ds_priority_delete_max(id) Returns the value with the largest priority and deletes it from the priority queue.

ds_priority_find_max(id) Returns the value with the largest priority but does not delete it from the priority queue.

ds_priority_write(id) Turns the data structure into a string and returns this string. The string can then be used to e.g. save it to a file. This provides an easy mechanism for saving data structures.

ds_priority_read(id,str) Reads the data structure from the given string (as created by the previous call).

Grids

Agrid is simply a two-dimensional array. Agrid has an integer width and height. The structure allows you to set and retrieve the value of cells in the grid by giving the index of it (which starts with 0 in both the x- and the y-direction). But you can also set the value in regions, add values, and retrieve the sum, max, min, and mean value over a region. The structure is useful to represent e.g. a playing field. Even though all functionality can also be achieved using two-dimensional arrays, the operations on regions are a lot faster. The following functions exist:

ds_grid_create(w,h) Creates a new grid with the indicated width and height. The function returns an integer as an id that must be used in all other functions to access the particular grid.

ds_grid_destroy(id) Destroys the grid with the given id, freeing the memory used. Don't forget to call this function when you are ready with the structure.

ds_grid_copy(id,source) Copies the grid source into the grid with the given id.

ds_grid_resize(id,w,h) Resizes the grid to the new width and height. Existing cells keep their original value.

ds_grid_width(id) Returns the width of the grid with the indicated id.

ds_grid_height(id) Returns the height of the grid with the indicated id.

ds_grid_clear(id,val) Clears the grid with the given id, to the indicated value (can both be a number or a string).

ds_grid_set(id,x,y,val) Sets the indicated cell in the grid with the given id, to the indicated value (can both be a number or a string).

ds_grid_add(id,x,y,val) Add the value to the indicated cell in the grid with the given id. For strings this corresponds to concatenation.

ds_grid_multiply(id,x,y,val) Multiplies the value to the indicated cell in the grid with the given id. Is only valid for numbers.

ds_grid_set_region(id,x1,y1,x2,y2,val) Sets the all cells in the region in the grid with the given id, to the indicated value (can both be a number or a string).

ds_grid_add_region(id,x1,y1,x2,y2,val) Add the value to the cell in the region in the grid with the given id. For strings this corresponds to concatenation.

ds_grid_multiply_region(id,x1,y1,x2,y2,val) Multiplies the value to the cells in the region in the grid with the given id. Is only valid for numbers.

ds_grid_set_disk(id,xm,ym,r,val) Sets all cells in the disk with center (xm,ym) and radius r.

ds_grid_add_disk(id,xm,ym,r,val) Add the value to all cells in the disk with center (xm,ym) and radius r.

ds_grid_multiply_disk(id,xm,ym,r,val) Multiply the value to all cells in the disk with center (xm,ym) and radius r.

ds_grid_set_grid_region(id,source,x1,y1,x2,y2,xpos,ypos) Copies the contents of the cells in the region in grid source to grid id. xpos and ypos indicate the place where the region must be placed in the grid. (Can also be used to copy values from one place in a grid to another.)

ds_grid_add_grid_region(id,source,x1,y1,x2,y2,xpos,ypos) Adds the contents of the cells in the region in grid source to grid id. xpos and ypos indicate the place where the region must be added in the grid. (id and source can be the same.)

ds_grid_multiply_grid_region(id,source,x1,y1,x2,y2,xpos,ypos) Multiplies the contents of the cells in the region in grid source to grid id. xpos and ypos indicate the place where the region must be multiplied in the grid. (id and source can be the same.) Only valid for numbers.

ds_grid_get(id,x,y) Returns the value of the indicated cell in the grid with the given id.

ds_grid_get_sum(id,x1,y1,x2,y2) Returns the sum of the values of the cells in the region in the grid with the given id. Does only work when the cells contain numbers.

ds_grid_get_max(id,x1,y1,x2,y2) Returns the maximum of the values of the cells in the region in the grid with the given id. Does only work when the cells contain numbers.

ds_grid_get_min(id,x1,y1,x2,y2) Returns the minimum of the values of the cells in the region in the grid with the given id. Does only work when the cells contain numbers.

ds_grid_get_mean(id,x1,y1,x2,y2) Returns the mean of the values of the cells in the region in the grid with the given id. Does only work when the cells contain numbers.

ds_grid_get_disk_sum(id,xm,ym,r) Returns the sum of the values of the cells in the disk.

ds_grid_get_disk_min(id,xm,ym,r) Returns the min of the values of the cells in the disk.

ds_grid_get_disk_max(id,xm,ym,r) Returns the max of the values of the cells in the disk.

ds_grid_get_disk_mean(id,xm,ym,r) Returns the mean of the values of the cells in the disk.

ds_grid_value_exists(id,x1,y1,x2,y2,val) Returns whether the value appears somewhere in the region.

ds_grid_value_x(id,x1,y1,x2,y2,val) Returns the x-coordinate of the cell in which the value appears in the region.

ds_grid_value_y(id,x1,y1,x2,y2,val) Returns the y-coordinate of the cell in which the value appears in the region.

ds_grid_value_disk_exists(id,xm,ym,r,val) Returns whether the value appears somewhere in the disk.

ds_grid_value_disk_x(id,xm,ym,r,val) Returns the x-coordinate of the cell in which the value appears in the disk.

ds_grid_value_disk_y(id,xm,ym,r,val) Returns the y-coordinate of the cell in which the value appears in the disk.

ds_grid_shuffle(id) Shuffles the values in the grid such that they end up in a random order.

ds_grid_write(id) Turns the data structure into a string and returns this string. The string can then be used to e.g. save it to a file. This provides an easy mechanism for saving data structures.

ds_grid_read(id,str) Reads the data structure from the given string (as created by the previous call).

Creare particelle

This functionality is only available in the Standard Edition of GameMaker.

Particle systems are meant to create special effects. Particles are small elements, represented by a little sprite. Such particles move around according to predefined rules and can change size, orientation, color, etc. while they move. Many such particles together can create e.g. fireworks, flames, explosions, rain, snow, star fields, flying debris, etc.

GameMaker contains an extensive particle system that can be used to create great effects. Because of its generality it is not simple to use so better read this section carefully before trying.

If this is too complicated for you, there is also a very simple mechanism to create different types of explosions, smoke, rain, and even fireworks.

Particle systems have many parameters and it is not always easy to understand how to create the effects you want. First of all there are particle types. A particle type defines a particular kind of particles. Such types have many parameters that describe the shape, size, color, and motion of the particles. Particle types need to be defined only once and can then be used everywhere in the game.

Secondly there are particle systems. There can be different particle systems in the game. A particle system can have particles of the different types. A particle system has emitters that create the particles, either continuously or in bursts. It can also have attractors that attract particles. Finally, it can have destroyers that destroy particles. Once particles are created in a particle system, they are automatically handled (updated and drawn) by the system.

Information on particles can be found in the following pages:

[Simple Effects](#)

[Particle Types](#)

[Particle Systems](#)

[Emitters](#)

[Attractors](#)

[Destroyers](#)

[Deflectors](#)

[Changers](#)

[Firework Example](#)

Simple Effects

The easiest way of creating particles is to use the effects mechanism. Effects are created using the particle system but you do not have to worry about all the details. You simply specify the type of effect, the position where it must be created, its size, and its color. That is all.

There are a number of different kinds of effects:

- `ef_explosion`
- `ef_ring`
- `ef_ellipse`
- `ef_firework`
- `ef_smoke`
- `ef_smokeup`
- `ef_star`
- `ef_spark`
- `ef_flare`
- `ef_cloud`
- `ef_rain`
- `ef_snow`

Some you want to create just once (like the explosion) and some you want to create in every step (like the smoke or the rain). Note that rain and snow are always created at the top of the room so the position is irrelevant in this case.

Even though this might sound limited, they can actually be used to create great effects. For example by creating a small puff of red smoke below a moving spaceship in each step, a tail of fire is created. The following two functions exist to create the effects:

`effect_create_below(kind,x,y,size,color)` Creates an effect of the given kind (see above) at the indicated position. size give the size as follows: 0 = small, 1 = medium, 2 = large. color indicates the color to be used. The effect is created below the instances, that is, at a depth of 100000.

`effect_create_above(kind,x,y,size,color)` Similar to the previous function but this time the effect is created on top of the instances, that is, at a depth of -100000.

If you want to remove all effects, call the following function:

`effect_clear()` Clears all effects.

Particle Types

A particle type describes the shape, color, motion, etc. of a particular kind of particles. You need to define a particle type only once in the game. After this it can be used in any particle system in the game. Particle Types have a large number of parameters that can be used to change all aspects of it. Setting these right you can create almost any effect you like. We will discuss the settings below.

A number of routines are available to create new particle types and destroy them again:

part_type_create() Creates a new particle type. It returns the index of the type. This index must be used in all calls below to set the properties of the particle type. So you will often store it in a global variable.

part_type_destroy(ind) Destroys particle type ind. Call this if you don't need it anymore to save space.

part_type_exists(ind) Returns whether the indicated particle type exists.

part_type_clear(ind) Clears the particle type ind to its default settings.

The shape of a particle

A particle has a shape. This shape is indicated by a sprite. You can use any sprite you like for your particles but there are 15 built-in sprites. These are all 64x64 in size and have alpha values set such that they nicely blend with the background. They are indicated by the following constants:

- `pt_shape_pixel`
- `pt_shape_disk`
- `pt_shape_square`
- `pt_shape_line`
- `pt_shape_star`
- `pt_shape_circle`
- `pt_shape_ring`
- `pt_shape_sphere`
- `pt_shape_flare`
- `pt_shape_spark`
- `pt_shape_explosion`
- `pt_shape_cloud`
- `pt_shape_smoke`
- `pt_shape_snow`

You set the shape using the following function:

part_type_shape(ind, shape) Sets the shape of the particle type to any of the constants above (default is `pt_shape_pixel`).

You can also use your own sprite for the particle. If the sprite has multiple subimages you can indicate what should be done with them. You can pick a random one, animate the sprite, start at the beginning of the animation or at a random place, etc.

You use the following function for this.

part_type_sprite(ind, sprite, animat, stretch, random) Sets your own sprite for the particle type. With `animate` you indicate whether the sprite should be animated (1) or not (0). With `stretch` (1 or 0) you indicate whether the animation must be stretched over the lifetime of the particle. And with `random` (1 or 0) you can indicate whether a random subimage must be chosen as starting image.

Once you have chosen the sprite for the particle type (either a default shape or your own) you can indicate the size of it. A size of 1 indicates the normal size of the sprite. A particle type can be defined such that all particles have the same size or have different sizes. You can indicate a range of sizes. Also, you can indicate whether the size should change over the lifetime of the particle and whether some wiggling in the size will happen, giving a blinking effect.

part_type_size(ind, size_min, size_max, size_incr, size_wiggle) Sets the size parameters for the

particle type. You specify the minimum starting size, the maximum starting size, the size increase in each step (use a negative number for a decrease in size) and the amount of wiggling. (The default size is 1 and default the size does not change.)

part_type_scale(ind, xscale, yscale) Sets the horizontal and vertical scale. This factor is multiplied with the size. It is in particular useful when you need to scale differently in x- and y-direction.

The particles also have an orientation. Again the orientation can be the same for all particles, can be different, and can change over the lifetime of the sprite. The angles specify counter-clockwise rotations, in degrees.

part_type_orientation(ind, ang_min, ang_max, ang_incr, ang_wiggle, ang_relative) Sets the orientation angle properties for the particle type. You specify the minimum angle, the maximum angle, the increase in each step and the amount of wiggling in angle. (Default all values are 0.) You can also indicate whether the given angle should be relative (1) to the current direction of motion or absolute (0). E.g. by setting all values to 0 but ang_relative to 1, the particle orientation will precisely follow the path of the particle.

Color and blending

Particles will have a color. There are different ways in which you can specify colors for a particle. The simplest way is to indicate a single color. You can also specify two or three colors between which the color of the particle is interpolated during its life time. For example, the particle can start white and become more and more black over its lifetime. Another possibility is that you indicate that the color of each particle must be different, picked from a range of colors. You can either give a range in red, green and blue, or a range in hue, saturation, and value.

Default the color is white. When you use a sprite with its own colors, this is normally what you want and no color needs to be specified.

part_type_color1(ind, color1) Indicates a single color to be used for the particle.

part_type_color2(ind, color1, color2) Specifies two colors between which the color is interpolated.

part_type_color3(ind, color1, color2, color3) Similar but this time the color is interpolated between three colors that represent the color at the start, half-way, and at the end.

part_type_color_mix(ind, color1, color2) With this function you indicate that the particle should get a color that is a random mixture of the two indicated colors. This color will remain fixed over the lifetime of the particle.

part_type_color_rgb(ind, rmin, rmax, gmin, gmax, bmin, bmax) Can be used to indicate that each particle must have a fixed color but chosen from a range. You specify a range in the red, green, and blue component of the color (each between 0 and 255).

part_type_color_hsv(ind, hmin, hmax, smin, smax, vmin, vmax) Can be used to indicate that each particle must have a fixed color but chosen from a range. You specify a range in the hue saturation and value component of the color (each between 0 and 255).

Besides the color you can also give an alpha transparency value. The built-in particle shapes already have some alpha transparency but you can use these settings to e.g. make the particle vanish over its life time.

part_type_alpha1(ind, alpha1) Sets a single alpha transparency parameter (0-1) for the particle type.

part_type_alpha2(ind, alpha1, alpha2) Similar but this time a start and end value are given and the alpha value is interpolated between them.

part_type_alpha3(ind, alpha1, alpha2, alpha3) This time three values are given between which the alpha transparency is interpolated.

Normally particles are blended with the background in the same way as sprites. But it is also possible to use additive blending. This gives in particular a great effect for explosion.

part_type_blend(ind, additive) Sets whether to use additive blending (1) or normal blending (0) for the particle type.

Life and death

Particles live for a limited amount of time, their lifetime. After this they disappear. Lifetime is measured in steps. You can indicate the lifetime (or a range of lifetimes) for each particle type. Particles can create new particles of different types. There are two ways for this. They can create new particles in each step or they can create particles when they die. Be careful that the total number of particles does not get too high.

part_type_life(ind,life_min,life_max) Sets the lifetime bounds for the particle type. (Default both are 100.)

part_type_step(ind,step_number,step_type) Sets the number and type of particles that must be generated in each step for the indicated particle type. If you use a negative value, in each step a particle is generated with a chance $-1/\text{number}$. So for example with a value of -5 a particle is generated on average once every 5 steps.

part_type_death(ind,death_number,death_type) Sets the number and type of particles that must be generated when a particle of the indicated type dies. Again you can use negative numbers to create a particle with a particular chance. Note that these particles are only created when the particle dies at the end of its life, not when it dies because of a destroyer (see below).

Particle motion

Particles can move during their lifetime. They can get an initial speed (or range of speeds) and direction, and the speed and direction can change over time. Also gravity can be defined that pulls the particles in a particular direction. The following functions exist for this:

part_type_speed(ind,speed_min,speed_max,speed_incr,speed_wiggle) Sets the speed properties for the particle type. (Default all values are 0.) You specify a minimal and maximal speed. A random value between the given bounds is chosen when the particle is created. You can indicate a speed increase in each step. Use a negative number to slow the particle down (the speed will never become smaller than 0). Finally you can indicate some amount of wiggling of the speed.

part_type_direction(ind,dir_min,dir_max,dir_incr,dir_wiggle) Sets the direction properties for the particle type. (Default all values are 0.) Again you specify a range of directions (in counterclockwise degrees; 0 indicated a motion to the right). For example, to let the particle move in a random direction choose 0 and 360 as values. You can specify an increase in direction for each step, and an amount of wiggling.

part_type_gravity(ind,grav_amount,grav_dir) Sets the gravity properties for the particle type. (Default there is no gravity.) You specify the amount of gravity to be added in each step and the direction. E.g. use 270 for a downwards direction.

Particle Systems

Particles live in particle systems. So to have particles in your game you need to create one or more particle systems. There can be different particle systems (but preferably keep their number small). For example, if your game has a number of balls and each ball should have a trail of particles, most likely each ball has its own particle system. The easiest way to deal with particle systems is to create one and then create particles in it, using the particle types you specified before. But, as we will see below, particle systems can contain emitters that automatically produce particles, attractors that attract them, and destroyers that destroy them.

Once particles are added to a particle system they are automatically updated each step and drawn. No further action is required. To make it possible that particles are drawn, behind, in front of, or between object instances, each particle system has a depth, similar to instances and tiles.

Particle Systems will live on forever after they are created. So even if you change room or restart the game, the systems and the particles remain. So you better make sure you destroy them once you no longer need them.

The following basic functions deal with particle systems:

part_system_create() Creates a new particle system. It returns the index of the system. This index must be used in all calls below to set the properties of the particle system.

part_system_destroy(ind) Destroys the particle system ind. Call this if you don't need it anymore to save space.

part_system_exists(ind) Returns whether the indicated particle system exists.

part_system_clear(ind) Clears the particle system ind to its default settings, removing all particles and emitter and attractors in it.

part_system_draw_order(ind,oldtonew) Sets the order in which the particle system draws the particles. When oldtonew is true the oldest particles are drawn first and the newer one lie on top of them (default). Otherwise the newest particles are drawn first. This can give rather different effects.

part_system_depth(ind,depth) Sets the depth of the particle system. This can be used to let the particles appear behind, in front of, or in between instances.

part_system_position(ind,x,y) Sets the position where the particle system is drawn. This is normally not necessary but if you want to have particles at a position relative to a moving object, you can set the position e.g. to that object.

As indicated above, the particle system is automatically updated and drawn. But sometimes this is not what you want. To facilitate this, you can switch off automatic updating or drawing and then decide yourself when to update or draw the particle system. For this you can use the following functions:

part_system_automatic_update(ind,automatic) Indicates whether the particle system must be updated automatically (1) or not (0). Default is 1.

part_system_automatic_draw(ind,automatic) Indicates whether the particle system must be drawn automatically (1) or not (0). Default is 1.

part_system_update(ind) This function updates the position of all particles in the system and lets the emitters create particles. You only have to call this when updating is not automatic. (Although sometimes it is also useful to call this function a couple of times to get the system going.)

part_system_drawit(ind) This function draws the particles in the system. You only have to call this when drawing is not automatic. It should be called in the draw event of some object.

The following functions deal with particles in a particle system:

part_particles_create(ind,x,y,parttype,number) This function creates `number` particles of the indicated type at position (x,y) in the system.

part_particles_create_color(ind,x,y,parttype,color,number) This function creates `number` particles of the indicated type at position (x,y) in the system with the indicated color. This is only useful when the particle type defines a single color (or does not define a color at all).

part_particles_clear(ind) This function removes all particles in the system.

part_particles_count(ind) This function returns the number of particles in the system.

Emitters

Emitters create particles. They can either create a continuous stream of particles or can burst out a number of particles when using the appropriate function. A particle system can have an arbitrary number of emitters. An emitter has the following properties:

- **xmin, xmax, ymin, ymax** indicate the extent of the region in which the particles are generated.
- **shape** indicates the shape of the region. It can have the following values:
 - `ps_shape_rectangle`
 - `ps_shape_ellipse`
 - `ps_shape_diamond`
 - `ps_shape_line`
- **distribution** indicates the distribution used to generate the particles. It can have the following values:
 - `ps_distr_linear` indicates a linear distribution, that is everywhere in the region the chance is equal
 - `ps_distr_gaussian` indicates a Gaussian distribution in which more particles are generated in the center than at the sides of the region
 - `ps_distr_invgaussian` indicates an inverse Gaussian distribution in which more particles are generated at the sides of the region than in the center
- **particle type** indicates the type of particles being generated
- **number** indicates the number of particles generated in each step. If smaller than 0, in each step a particle is generated with a chance $-1/\text{number}$. So for example with a value of -5 a particle is generated on average once every 5 steps.

The following functions are available to set the emitters and to let them create particles. Note that each of them gets the index of the particle system to which it belongs as a first argument.

part_emitter_create(ps) Creates a new emitter in the given particle system. It returns the index of the emitter. This index must be used in all calls below to set the properties of the emitter.

part_emitter_destroy(ps, ind) Destroys emitter `ind` in the particle system. Call this if you don't need it anymore to save space.

part_emitter_destroy_all(ps) Destroys all emitters in the particle system that have been created.

part_emitter_exists(ps, ind) Returns whether the indicated emitter exists in the particle system.

part_emitter_clear(ps, ind) Clears the emitter `ind` to its default settings.

part_emitter_region(ps, ind, xmin, xmax, ymin, ymax, shape, distribution) Sets the region and distribution for the emitter.

part_emitter_burst(ps, ind, parttype, number) Bursts once `number` particles of the indicated type from the emitter.

part_emitter_stream(ps, ind, parttype, number) From this moment on create `number` particles of the indicated type from the emitter in every step. If you indicate a number smaller than 0 in each step a particle is generated with a chance of $-1/\text{number}$. So for example with a value of -5 a particle is generated on average once every 5 steps.

Attractors

Besides emitters a particle system can also contain attractors. An attractor attracts the particles (or pushes them away). A particle system can have multiple attractors. You are though recommended to use few of these because they will slow down the processing of the particles. An attractor has the following properties:

- **x, y** indicate the position of the attractor.
- **force** indicates the attracting force of the attractor. How the force acts on the particles depends on the following parameters.
- **dist** indicates the maximal distance at which the attractor has effect. Only particles closer than this distance to the attractor will be attracted.
- **kind** indicates the kind of attractor. The following values exist
 - `ps_force_constant` indicates that the force is constant independent of the distance.
 - `ps_force_linear` indicates a linearly growing force. At the maximal distance the force is 0 while at the position of the attractor it attains the given value.
 - `ps_force_quadratic` indicates that the force grows quadratic.
- **additive** indicates whether the force is added to the speed and direction in each step (true) or only applied to the position of the particle (false). When additive the particle will accelerate towards the attractor while with a non-additive force it will move there with constant speed.

The following functions exist to define attractors. Note that each of them gets the index of the particle system to which it belongs as a first argument.

part_attractor_create(ps) Creates a new attractor in the given particle system. It returns the index of the attractor. This index must be used in all calls below to set the properties of the attractor.

part_attractor_destroy(ps, ind) Destroys attractor ind in the particle system. Call this if you don't need it anymore to save space.

part_attractor_destroy_all(ps) Destroys all attractors in the particle system that have been created.

part_attractor_exists(ps, ind) Returns whether the indicated attractor exists in the particle system.

part_attractor_clear(ps, ind) Clears the attractor ind to its default settings.

part_attractor_position(ps, ind, x, y) Sets the position of attractor ind to (x,y).

part_attractor_force(ps, ind, force, dist, kind, additive) Sets the force parameters of attractor ind.

Destroyers

Destroyers destroy particles when they appear in their region. A particle system can have an arbitrary number of destroyers. A destroyer has the following properties:

- **xmin, xmax, ymin, ymax** indicates the extent of the region in which the particles are destroyed.
- **shape** indicates the shape of the region. It can have the following values:
 - `ps_shape_rectangle`
 - `ps_shape_ellipse`
 - `ps_shape_diamond`

The following functions are available to set the properties of the destroyers. Note that each of them gets the index of the particle system to which it belongs as a first argument.

part_destroyer_create(ps) Creates a new destroyer in the given particle system. It returns the index of the destroyer. This index must be used in all calls below to set the properties of the destroyer.

part_destroyer_destroy(ps, ind) Destroys destroyer `ind` in the particle system. Call this if you don't need it anymore to save space.

part_destroyer_destroy_all(ps) Destroys all destroyers in the particle system that have been created.

part_destroyer_exists(ps, ind) Returns whether the indicated destroyer exists in the particle system.

part_destroyer_clear(ps, ind) Clears the destroyer `ind` to its default settings.

part_destroyer_region(ps, ind, xmin, xmax, ymin, ymax, shape) Sets the region for the destroyer.

Deflectors

Deflectors deflect particles when they appear in their region. Note that only the position of the particle is taken into account not its sprite or size. A particle system can have an arbitrary number of deflectors. A deflector has the following properties:

- **xmin, xmax, ymin, ymax** indicates the extent of the region in which the particles are deflected.
- **kind** indicates the kind of deflector. It can have the following values:
 - `ps_deflect_horizontal` deflects the particle horizontally; typically used for vertical walls
 - `ps_deflect_vertical` deflects the particle vertically; typically used for horizontal walls
- **friction** the amount of friction as a result of the impact with the deflector. The higher this amount the more the particle is slowed down on impact.

The following functions are available to set the properties of the deflector. Note that each of them gets the index of the particle system to which it belongs as a first argument.

`part_deflector_create(ps)` Creates a new deflector in the given particle system. It returns the index of the deflector. This index must be used in all calls below to set the properties of the deflector.

`part_deflector_destroy(ps, ind)` Destroys deflector `ind` in the particle system. Call this if you don't need it anymore to save space.

`part_deflector_destroy_all(ps)` Destroys all deflectors in the particle system that have been created.

`part_deflector_exists(ps, ind)` Returns whether the indicated deflector exists in the particle system.

`part_deflector_clear(ps, ind)` Clears the deflector `ind` to its default settings.

`part_deflector_region(ps, ind, xmin, xmax, ymin, ymax)` Sets the region for the deflector.

`part_deflector_kind(ps, ind, kind)` Sets the kind for the deflector.

`part_deflector_friction(ps, ind, friction)` Sets the friction for the deflector.

Changers

Changers change certain particles when they appear in their region. A particle system can have an arbitrary number of changers. A changer has the following properties:

- **xmin, xmax, ymin, ymax** indicates the extent of the region in which the particles are changed.
- **shape** indicates the shape of the region. It can have the following values:
 - `ps_shape_rectangle`
 - `ps_shape_ellipse`
 - `ps_shape_diamond`
- **parttype1** indicates the particle type that is changed.
- **parttype2** indicates the particle type into which it is changed.
- **kind** indicates the kind of changer. It can have the following values:
 - `ps_change_motion` only changes the motion parameters of the particle, not the color and shape or lifetime settings.
 - `ps_change_shape` only changes the shape parameters like size and color and shape.
 - `ps_change_all` changes all parameters, this basically means that the particle is destroyed and a new one of the new type is created.

The following functions are available to set the properties of the changer. Note that each of them gets the index of the particle system to which it belongs as a first argument.

part_changer_create(ps) Creates a new changer in the given particle system. It returns the index of the changer. This index must be used in all calls below to set the properties of the changer.

part_changer_destroy(ps, ind) Destroys changer ind in the particle system. Call this if you don't need it anymore to save space.

part_changer_destroy_all(ps) Destroys all changers in the particle system that have been created.

part_changer_exists(ps, ind) Returns whether the indicated changer exists in the particle system.

part_changer_clear(ps, ind) Clears the changer ind to its default settings.

part_changer_region(ps, ind, xmin, xmax, ymin, ymax, shape) Sets the region for the changer.

part_changer_types(ps, ind, parttype1, parttype2) Sets which particle type the changer must change into what other type.

part_changer_kind(ps, ind, kind) Sets the kind for the changer.

Firework Example

Here is an example of a particle system that creates fireworks. The firework uses two particle types: one that forms the rocket and one that forms the actual fireworks. The rocket generates the firework particles when it dies. We also generate one emitter in the particle system that regularly stream out rocket particles along the bottom of the screen. To make this work you need an object. In its creation event we place the following code that creates the particle types, particle system, and the emitter:

```
{
    // make the particle system
    ps = part_system_create();

    // the firework particles
    pt1 = part_type_create();
    part_type_shape(pt1,pt_shape_flare);
    part_type_size(pt1,0.1,0.2,0,0);
    part_type_speed(pt1,0.5,4,0,0);
    part_type_direction(pt1,0,360,0,0);
    part_type_color1(pt1,c_red);
    part_type_alpha2(pt1,1,0.4);
    part_type_life(pt1,20,30);
    part_type_gravity(pt1,0.2,270);

    // the rocket
    pt2 = part_type_create();
    part_type_shape(pt2,pt_shape_sphere);
    part_type_size(pt2,0.2,0.2,0,0);
    part_type_speed(pt2,10,14,0,0);
    part_type_direction(pt2,80,100,0,0);
    part_type_color2(pt2,c_white,c_gray);
    part_type_life(pt2,30,60);
    part_type_gravity(pt2,0.2,270);
    part_type_death(pt2,150,pt1);    // create the firework on death

    // create the emitter
    em = part_emitter_create(ps);
    part_emitter_region(ps,em,100,540,480,490,ps_shape_rectangle,ps_distr_linear);
    part_emitter_stream(ps,em,pt2,-4);    // create one every four steps
}
```

That will do the trick. You might want to make sure the particle system (and maybe particle types) are destroyed when moving to another room, otherwise the firework will continue forever.

Giochi multiplayer

This functionality is only available in the Standard Edition of GameMaker.

Playing games against the computer is fun. But playing games against other human players can be even more fun. It is also relatively easy to make such games because you don't have to implement complicated computer opponent AI. You can of course sit with two players behind the same monitor and use different keys or other input devices, but it is a lot more interesting when each player can sit behind his own computer. Or even better, one player sits on the other side of the ocean. *GameMaker* has multiplayer support. Please realize that creating effective multiplayer games that synchronize well and have no latency is a difficult task. This chapter gives a brief description of the possibilities. On the website a tutorial is available with more information.

Information on multiplayer games can be found in the following pages:

[Setting up a Connection](#)

[Creating and Joining Sessions](#)

[Players](#)

[Shared Data](#)

[Messages](#)

Setting up a connection

For two computer to communicate they will need some connection protocol. Like most games, *GameMaker* offers four different types of connections: IPX, TCP/IP, Modem, and Serial. The IPX connection (to be more precise, it is a protocol) is almost completely transparent. It can be used to play games with other people on the same local area network. It needs to be installed on your computer to be used. (If it does not work, consult the documentation of Windows. Or go to the Network item in the control panel of Windows and add the IPX protocol.) TCP/IP is the internet protocol. It can be used to play with other players anywhere on the internet, assuming you know their IP address. On a local network you can use it without providing addresses. A modem connection is made through the modem. You have to provide some modem settings (an initialization string and a phone number) to use it. Finally, when using a serial line (a direct connection between the computers) you need to provide a number of port settings. There are four GML functions that can be used for initializing these connections:

`mplay_init_ipx()` initializes an IPX connection.

`mplay_init_tcpip(addr)` initializes a TCP/IP connection. `addr` is a string containing the web address or IP address, e.g. 'www.gameplay.com' or '123.123.123.12', possibly followed by a port number (e.g. ':12'). Only when joining a session (see below) do you need to provide an address. On a local area network no addresses are necessary.

`mplay_init_modem(initstr,phonenr)` initializes a modem connection. `initstr` is the initialization string for the modem (can be empty). `phonenr` is a string that contains the phone number to ring (e.g. '0201234567'). Only when joining a session (see below) do you need to provide a phone number.

`mplay_init_serial(portno,baudrate,stopbits,parity,flow)` initializes a serial connection. `portno` is the port number (1-4). `baudrate` is the baudrate to be used (100-256K). `stopbits` indicates the number of stopbits (0 = 1 bit, 1 = 1.5 bit, 2 = 2 bits). `parity` indicates the parity (0=none, 1=odd, 2=even, 3=mark). And `flow` indicates the type of flow control (0=none, 1=xon/xoff, 2=rts, 3=dtr, 4=rts and dtr). Returns whether successful. A typical call is `mplay_init_serial(1,57600,0,0,4)`. Give 0 as a first argument to open a dialog for the user to change the settings.

Your game should call one of these functions exactly once. All functions report whether they were successful. They are not successful if the particular protocol is not installed or supported by your machine. To check whether there is a successful connection available you can use the following function

`mplay_connect_status()` returns the status of the current connection. 0 = no connection, 1 = IPX connection, 2 = TCP/IP connection, 3 = modem connection, and 4 = serial connection.

To end the connection call

`mplay_end()` ends the current connection.

When using a TCP/IP connection you might want to tell the person you want to play the game with what the ip address of your computer is. The following function helps you here:

`mplay_ipaddress()` returns the IP address of your machine (e.g. '123.123.123.12') as a string. You can e.g. display this somewhere on the screen. Note that this routine is slow so don't call it all the time.

Creando ed entrando nelle sessioni

Quando ti connetti ad una rete, ci possono essere multipli giochi che avvengono sulla stessa rete. Chiamiamo queste sessioni. Ci sono differenti sessioni che possono corrispondere a diversi giochi o allo stesso gioco. Un gioco deve unicamente identificarsi da solo alla rete. Fortunatamente, *GameMaker* fa' questo per te. L'unica cosa che devi sapere e che quando cambi l'id del gioco nel form delle opzioni questo identifica cambiamenti. In questo modo puoi evitare che le persone con vecchie versioni del tuo gioco giocheranno contro persone con nuove versioni.

Se vuoi iniziare un nuovo gioco multigiocatore chiedi di creare una nuova sessione. Per questo tu puoi usare le seguenti routine:

`mplay_session_create(sesname,playnumb,playername)` crea una nuova sessione sulla connessione corrente. `sesname` Ã una stringa indicante il nome della sessione. `playnumb` Ã il numero che indica il numero di giocatori massimi accettati in questo gioco (usa 0 per un numero arbitrario). `playname` Ã il tuo nome come giocatore. Ritorna quando ha successo.

Un'istanza del gioco deve creare la sessione. L'altra istanza(e) del tuo gioco dovrebbero entrare in questa sessione. Questo Ã leggermente piÃ complicato. Prima chiedi di vedere quali sessioni sono disponibili e poi scegli una da entrare. Ci sono tre importanti routines per questo:

`mplay_session_find()` cerca per tutte le sessioni che accettano ancora giocatori e ritorna il numero di sessioni trovate.

`mplay_session_name(numb)` ritorna il nome della sessione numero `numb` (0 Ã la prima sessione). Questa routine puÃ essere chiamata solo dove aver chiamato la precedente routine.

`mplay_session_join(numb,playername)` Ti fa' entrare nella sessione numero `numb` (0 Ã la prima sessione). `playname` Ã il tuo nome come giocatore. Ritorna quando ha successo.

C'Ã un'altra routine che puÃ cambiare la modalitÃ della sessione. Dovrebbe essere chiamata prima di creare una sessione:

`mplay_session_mode(move)` imposta quando o no muovere l'host della sessione ad un altro computer quando l'host termina. `move` dovrebbe essere sia true o false (predefinito).

Per controllare lo stato della sessione attuale puoi usare le seguenti funzioni

`mplay_session_status()` ritorna lo stato della sessione attuale. 0 = nessuna sessione, 1 = sessione creata, 2 = entrato nella sessione.

Un giocatore puÃ fermare una sessione usando la seguente routine:

`mplay_session_end()` termina la sessione per questo giocatore

Players

Each instance of the game that joins a session is a player. As indicated above, players have names. There are three routines that deal with players.

`mplay_player_find()` searches for all players in the current session and returns the number of players found.

`mplay_player_name(numb)` returns the name of player number numb (0 is the first player, which is always yourself). This routine can only be called after calling the previous routine.

`mplay_player_id(numb)` returns the unique id of player number numb (0 is the first player, which is always yourself). This routine can only be called after calling the first routine. This id is used in sending and receiving messages to and from individual players.

Shared Data

Shared Data communication is probably the easiest way to synchronize the game. All communication is shielded from you. There is a set of 1000000 values that are common to all entities of the game (preferably only use the first few to save memory). Each entity can set values and read values. *GameMaker* makes sure that each entity sees the same values. A value can either be a real or a string. There are just two routines:

`mplay_data_write(ind, val)` write value `val` (string or real) into location `ind` (`ind` between 0 and 1000000).
`mplay_data_read(ind)` returns the value in location `ind` (`ind` between 0 and 1000000). Initially all values are 0.

To synchronize the data on the different machines you can either use a guaranteed mode that makes sure that the change arrives on the other machine (but which is slow) or non-guaranteed. To change this use the following routine:

`mplay_data_mode(guar)` sets whether or not to use guaranteed transmission for shared data. `guar` should either be true (the default) or false.

Messages

The second communication mechanism that *GameMaker* supports is the sending and receiving of messages. A player can send messages to one or all other players. Players can see whether messages have arrived and take action accordingly. Messages can be sent in a guaranteed mode in which you are sure they arrive (but this can be slow) or in a non-guaranteed mode, which is faster.

The following messaging routines exist:

`mplay_message_send(player, id, val)` sends a message to the indicated player (either an identifier or a name; use 0 to send the message to all players). `id` is an integer message identifier and `val` is the value (either a real or a string). The message is sent in non-guaranteed mode. If `val` contains a string the maximal string length allowed is 30000 characters.

`mplay_message_send_guaranteed(player, id, val)` sends a message to the indicated player (either an identifier or a name; use 0 to send the message to all players). `id` is an integer message identifier and `val` is the value (either a real or a string). This is a guaranteed send. If `val` contains a string the maximal string length allowed is 30000 characters.

`mplay_message_receive(player)` receives the next message from the message queue that came from the indicated player (either an identifier or a name). Use 0 for messages from any player. The routine returns whether there was indeed a new message. If so you can use the following routines to get its contents:

`mplay_message_id()` Returns the identifier of the last received message.

`mplay_message_value()` Returns the value of the last received message.

`mplay_message_player()` Returns the player who sent the last received message.

`mplay_message_name()` Returns the name of the player who sent the last received message.

`mplay_message_count(player)` Returns the number of messages left in the queue from the player (use 0 to count all message).

`mplay_message_clear(player)` Removes all messages left in the queue from the player (use 0 to remove all message).

A few remarks are pertinent here. First of all, if you want to send a message to a particular player only, you will need to know the player's unique id. As indicated earlier you can obtain this with the function `mplay_player_id()`. This player identifier is also used when receiving messages from a particular player. Alternatively, you can give the name of the player as a string. If multiple players have the same name, only the first will get the message.

Secondly, you might wonder why each message has an integer identifier. The reason is that this helps your application to send different types of messages. The receiver can check the type of message using the id and take appropriate actions. (Because messages are not guaranteed to arrive, sending id and value in different messages would cause serious problems.)

Usare le DLL

This functionality is only available in the Standard Edition of GameMaker.

Please note that since version 7 there is a new extension mechanism in GameMaker. You are strongly encouraged to use that extension mechanism, rather than the functions described in this section. See

<http://www.yoyogames.com/extensions> for details. These functions are mainly left in for compatibility with the past.

In those cases where the functionality of GML is not enough for your wishes, you can actually extend the possibilities by using plug-ins. A plug-in comes in the form of a DLL file (a Dynamic Link Library). In such a DLL file you can define functions. Such functions can be programmed in any programming language that supports the creation of DLL's (e.g. Delphi, C, C++, etc.) You will though need to have some programming skill to do this. Plug-in functions must have a specific format. They can have between 0 and 16 arguments, each of which can either be a real number (double in C) or a null-terminated string. (For more than 4 arguments, only real arguments are supported at the moment.) They must return either a real or a null-terminated string.

In Delphi you create a DLL by first choosing **New** from the **File** menu and then choosing DLL. Here is an example of a DLL you can use with *GameMaker* written in Delphi. (Note that this is Delphi code, not GML code!)

```
library MyDLL;

uses SysUtils, Classes;

function MyMin(x,y:double):double; cdecl;
begin
    if x<y then Result := x else Result := y;
end;

var res : array[0..1024] of char;

function DoubleString(str:PChar):PChar; cdecl;
begin
    StrCopy(res,str);
    StrCat(res,str);
    Result := res;
end;

exports MyMin, DoubleString;

begin
end.
```

This DLL defines two functions: `MyMin` that takes two real arguments and returns the minimum of the two, and `DoubleString` that doubles the string. Note that you have to be careful with memory management. That is why I declared the resulting string global. Also notice the use of the `cdecl` calling convention. You can either use `cdecl` or `stdcall` calling conventions. Once you build the DLL in Delphi you will get a file `MyDLL.DLL`. This file must be placed in the running directory of your game. (Or any other place where Windows can find it.)

To use this DLL in *GameMaker* you first need to specify the external functions you want to use and what type of arguments they take. For this there is the following function in GML:

external_define(dll,name,calltype,restype,argnumb,arg1type,arg2type, ...) Defines an external function. `dll` is the name of the dll file. `name` is the name of the functions. `calltype` is the calling convention used. For this use either `dll_cdecl` or `dll_stdcall`. `restype` is the type of the result. For this use either `ty_real` or `ty_string`. `argnumb` is the number of arguments (0-16). Next, for each argument you must specify its type. For this again use either `ty_real` or `ty_string`. When there are more than 4 arguments all of them must be

of type `ty_real`.

This function returns the id of the external function that must be used for calling it. So in the above example, at the start of the game you would use the following GML code:

```
{
    global.mmm = external_define('MyDLL.DLL', 'MyMin', dll_cdecl,
                                ty_real, 2, ty_real, ty_real);
    global.ddd = external_define('MyDLL.DLL', 'DoubleString', dll_cdecl,
                                ty_string, 1, ty_string);
}
```

Now whenever you need to call the functions, you use the following function:

external_call(id, arg1, arg2, ...) Calls the external function with the given id, and the given arguments. You need to provide the correct number of arguments of the correct type (real or string). The function returns the result of the external function.

So, for example, you would write:

```
{
    aaa = external_call(global.mmm, x, y);
    sss = external_call(global.ddd, 'Hello');
}
```

If you don't need to use the DLL anymore you had better free it.

external_free(dll) Frees the DLL with the given name. This is in particular necessary if the game should remove the DLL. As long as the DLL is not freed it cannot be removed. Best do this e.g. in an end of game event.

You might wonder how to make a function in a DLL that does something in the game. For example, you might want to create a DLL that adds instances of objects to your game. The easiest way is to let your DLL function return a string that contains a piece of GML code. This string that contains the piece of GML can be executed using the GML function

execute_string(str, arg0, arg1, ...) Execute the piece of code in the string `str` with the indicated arguments.

Alternatively you can let the DLL create a file with a script that can be executed (this function can also be used to later modify the behavior of a game).

execute_file(fname) Execute the piece of code in the file.

Now you can call an external function and then execute the resulting string, e.g. as follows:

```
{
    ccc = external_call(global.ddd, x, y);
    execute_string(ccc);
}
```

In some rare cases your DLL might need to know the handle of the main graphics window for the game. This can be obtained with the following function and can then be passed to the DLL:

window_handle() Returns the window handle for the main window.

Note that DLLs cannot be used in secure mode.

Using external DLLs is an extremely powerful mechanism. But please only use it if you know what you are doing.

get_function_address('function_name') Returns the address of a GameMaker function. This can be passed to DLL's so they can call directly into GameMaker.

This feature is unsupported, so care must be taken when using this function.

Please Note: These functions use Delphi 2010 PASCAL calling convention and string formats.

Grafica 3D

This functionality is only available in the Standard Edition of GameMaker.

GameMaker is a program meant for making 2-dimensional and isometric games. Still there is some functionality to create 3-dimensional graphics. Before you start with this though there are a few things you must understand.

- The 3D functionality in *GameMaker* is limited to the graphics part. There is no support for other 3D functionality. Once you start using 3D graphics you might get problems with other aspects of *GameMaker*, like the views, depth ordering, etc. The functionality is limited and has low priority to be extended. So don't expect support for 3D object models, etc.
- When you use the 3D functionality, there are a number of other things that can no longer be used.
 - You cannot use background and foregrounds in your rooms anymore. (The reason is that they are tiled to fill the image but with perspective projections this no longer work correctly).
 - You cannot use the mouse position anymore. The mouse will not be transformed to the 3D coordinates. You can still get the position of the mouse on the screen (in the view) but you will have to do calculation with this yourself (or not use the mouse at all).
 - You cannot use tiles anymore. Tiles will most likely no longer match up correctly.
 - Collision checking still uses the 2-d positions of the instances in the room. So there is no collision detection in 3D. Sometimes you can still use this (if you use the room as a representation of a flat world (e.g. for racing or FPS games) but in other situations you have to do things yourself.
- All 3D functionality is through code. You must be rather fluent with the GML language. Also you must really understand a lot about how *GameMaker* works otherwise you will run into trouble.
- You must have some basic knowledge about 3D graphics. In particular I will use terms like perspective projections, hidden surface removal, lighting, and fog, without much explanation.
- There is no 3D modelling in *GameMaker*. Also I do not plan on adding support for loading 3D models.
- You must work carefully to keep a reasonable speed. Also, things are not really optimized for speed.

If this did not discourage you, read on.

Information on 3d graphics can be found in the following pages:

- [Going to 3D mode](#)
- [Easy drawing](#)
- [Drawing polygons in 3D](#)
- [Drawing basic shapes](#)
- [Viewing the world](#)
- [Transformations](#)
- [Fog](#)
- [Lighting](#)
- [Creating models](#)
- [Final words](#)

Going to 3D mode

If you want to use 3D mode you first need to set *GameMaker* in 3D mode. You can later switch back to 2D mode if you want. The following two functions exist for this.

d3d_start() Start using 3D mode. Returns whether successful.

d3d_end() Stop using 3D mode. Returns whether successful.

Note that all functions related to 3D mode start with `d3d_`.

Starting 3D mode will result in the following changes. First of all depth testing (also known as Z Buffering) is switched on (using a 24-bit z-buffer). This means that for each pixel on the screen only the drawing with the smallest z-value (= depth value) is drawn. If instances have the same depth then you will get what is known as Z-fighting. This occurs as the 2 instances attempt to draw at the same level, and inaccuracies in the rendering due to very close Z value cause ugly effects. To avoid this, try and make sure instances that might overlap do not have the same depth value!

Secondly, the normal orthographic projection is replaced by a perspective one. This means the following. Normally the size of instances on the screen is independent on its depth. With a perspective projection instances that have a greater depth will appear smaller. When the depth is 0 it is equal to the old size (unless you change the projection; see below). The viewpoint for the camera is placed at a distance above the room. (This distance is equal to the width of the room; that gives a reasonable default projection.) Only instances in front of the camera are drawn. So don't use instances with a depth smaller than 0 (or at least not smaller than -w where w is the width of the room or the view).

Thirdly, the vertical y-coordinate is reversed. While normally the (0,0) position is at the top-left of the view, in 3D mode the (0,0) position is at the bottom-left position, as is normal for 3-dimensional views.

You can actually switch hidden surface remove and perspective projection on or off using the following functions.

d3d_set_hidden(enable) Enables (true) or disables (false) depth testing.

d3d_set_perspective(enable) Enables the use of a perspective projection (true) or disables it (false).

Easy drawing

Once 3D mode has been switched on you can use *GameMaker* as you are used to it (except for the remarks made at the beginning). Only objects will appear in different sizes based on their depth setting. You can even use views. One additional function can be useful. If you draw a number of things in a piece of code you might want to change the depth value between the primitives you draw. For this you use:

`d3d_set_depth(depth)` Sets the depth used for drawing.

Note that at the moment a new instance is drawn the depth is again set to the depth of that instance.

Drawing polygons in 3D

The problem with drawing in the old way is that a sprite or polygon always lies in the xy-plane, that is, all corners have the same depth. For true 3D you want to be able to have vertices at different depths. From this moment on we will talk about z-coordinate rather than depth. So we want to specify coordinates as (x,y,z) tuples. For this there are special version of the advanced drawing functions:

d3d_primitive_begin(kind) Start a 3D primitive of the indicated kind: `pr_pointlist`, `pr_linelist`, `pr_linestrip`, `pr_trianglelist`, `pr_trianglestrip` or `pr_trianglefan`.

d3d_vertex(x,y,z) Add vertex (x,y,z) to the primitive, using the color and alpha value set before.

d3d_vertex_color(x,y,z,col,alpha) Add vertex (x,y,z) to the primitive, with its own color and alpha value.

This allows you to create primitives with smoothly changing color and alpha values.

d3d_primitive_end() End the description of the primitive. This function actually draws it.

For example, to draw a tetrahedron (three sided pyramid) standing on the z=0 plane with its top at z = 200, you can use the following code:

```
{
    d3d_primitive_begin(pr_trianglelist);
    d3d_vertex(100,100,0);
    d3d_vertex(100,200,0);
    d3d_vertex(150,150,200);
    d3d_vertex(100,200,0);
    d3d_vertex(200,200,0);
    d3d_vertex(150,150,200);
    d3d_vertex(200,200,0);
    d3d_vertex(100,100,0);
    d3d_vertex(150,150,200);
    d3d_vertex(100,100,0);
    d3d_vertex(100,200,0);
    d3d_vertex(200,200,0);
    d3d_primitive_end();
}
```

Now if you would use this, most likely you would just see a triangle on the screen because the top of the tetrahedron will be behind it from the viewpoint. Also, using just one color, it would be difficult to see the different faces. Below we will see ways to change the viewpoint. Assigning colors can be done as before by added `draw_set_color(col)` function calls between the vertices.

You can also use textured polygons in 3D. It works exactly the same as described in the advanced drawing functions in the documentation. But this time you need 3D variants of the basic functions. One thing you must realize. In a texture the position (0,0) is the top-left corner. But often, when using projections (as indicated below), the bottom-left corner is (0,0). In such a case you might need to flip the texture vertically.

d3d_primitive_begin_texture(kind,texid) Start a 3D primitive of the indicated kind with the given texture.

d3d_vertex_texture(x,y,z,xtex,ytex) Add vertex (x,y,z) to the primitive with position (xtex,ytex) in the texture, blending with the color and alpha value set before.

d3d_vertex_texture_color(x,y,z,xtex,ytex,col,alpha) Add vertex (x,y,z) to the primitive with position (xtex,ytex) in the texture, blending with its own color and alpha value.

d3d_primitive_end() End the description of the primitive. This function actually draws it.

So, for example you can use the following code to draw a background image that disappears into the distance

```
{
    var ttt;
```

```
    ttt = background_get_texture(back);  
    d3d_primitive_begin_texture(pr_trianglefan, ttt);  
        d3d_vertex_texture(0, 480, 0, 0, 0);  
        d3d_vertex_texture(640, 480, 0, 1, 0);  
        d3d_vertex_texture(640, 480, 1000, 1, 1);  
        d3d_vertex_texture(0, 480, 1000, 0, 1);  
    d3d_primitive_end();  
}
```

A triangle has a front and a back side. The front side is defined to be the side where the vertices are defined in counter-clockwise order. Normally both sides are drawn. But if you make a closed shape this is a waste because the back side of the triangle can never be seen. In this case you can switch on backface culling. This saves about half the amount of drawing time but it leaves you with the task of defining your polygons in the right way. The following function exists:

d3d_set_culling(cull) Indicates to start backface culling (true) or stop backface culling (false).

Drawing basic shapes

A number of functions exist for drawing basic shapes, like blocks and walls. Note that these shapes also work correctly with backface culling on.

d3d_draw_block(x1,y1,z1,x2,y2,z2, texid, hrepeat, vrepeat) Draws a block in the current color with the indicated opposite corners using the indicated texture. Use -1 to not use a texture. *hrepeat* indicates how often the texture must be repeated along the horizontal edge of each face. *vrepeat* does the same for the vertical edge.

d3d_draw_cylinder(x1,y1,z1,x2,y2,z2, texid, hrepeat, vrepeat, closed, steps) Draws a vertical cylinder in the current color in the indicated bounding box using the indicated texture. Use -1 to not use a texture. *hrepeat* indicates how often the texture must be repeated along the horizontal edge of each face. *vrepeat* does the same for the vertical edge. *closed* indicates whether to close the top and bottom of the cylinder. *steps* indicates how many rotational steps must be taken. Atypical value is 24.

d3d_draw_cone(x1,y1,z1,x2,y2,z2, texid, hrepeat, vrepeat, closed, steps) Draws a vertical cone in the current color in the indicated bounding box using the indicated texture. Use -1 to not use a texture. *hrepeat* indicates how often the texture must be repeated along the horizontal edge of each face. *vrepeat* does the same for the vertical edge. *closed* indicates whether to close the top and bottom of the cylinder. *steps* indicates how many rotational steps must be taken. Atypical value is 24.

d3d_draw_ellipsoid(x1,y1,z1,x2,y2,z2, texid, hrepeat, vrepeat, steps) Draws an ellipsoid in the current color in the indicated bounding box using the indicated texture. Use -1 to not use a texture. *hrepeat* indicates how often the texture must be repeated along the horizontal edge of each face. *vrepeat* does the same for the vertical edge. *steps* indicates how many rotational steps must be taken. Atypical value is 24.

d3d_draw_wall(x1,y1,z1,x2,y2,z2, texid, hrepeat, vrepeat) Draws a vertical wall in the current color with the given corners using the indicated texture. Use -1 to not use a texture. *hrepeat* indicates how often the texture must be repeated along the horizontal edge of each face. *vrepeat* does the same for the vertical edge.

d3d_draw_floor(x1,y1,z1,x2,y2,z2, texid, hrepeat, vrepeat) Draws a (slanted) floor in the current color with the given corners using the indicated texture. Use -1 to not use a texture. *hrepeat* indicates how often the texture must be repeated along the horizontal edge of each face. *vrepeat* does the same for the vertical edge.

The following piece of code draws two blocks:

```
{
    var ttt;
    ttt = background_get_texture(back);
    d3d_draw_block(20,20,20,80,40,200,ttt,1,1);
    d3d_draw_block(200,300,-10,240,340,100,ttt,1,1);
}
```


Viewing the world

Default you look along the negative z-axis toward the middle of the room. Often in 3D games you want to change how you look at the world. For example, in a first person shooter you probably want to have the camera look from a position a bit above the xy-plane along the xy-plane. In graphics terms you are setting the correct projection. To change the way you look the following two functions exist.

d3d_set_projection(xfrom,yfrom,zfrom,xto,yto,zto,xup,yup,zup) Defines how to look in the world. You specify the point to look from, the point to look to and the up vector.

This function requires some explanation. To set the projection you first need the position you look from. This is indicated by the parameters (xfrom,yfrom,zfrom). Next you must specify the direction you look in. This is done by giving a second point to look towards. This is the point (xto,yto,zto). Finally, you can still rotate the camera around the line from the viewpoint to the looking point. To specify this we must give an up vector, that is, the direction that is upwards in the camera. This is given by the last three parameters (xup,yup,zup). Let me give an example. To look along the xy-plane as in a first person shooter you can use

```
{
    d3d_set_projection(100,100,10,200,100,10,0,0,1);
}
```

So you look from point (100,100) and 10 above the plane in the direction of (200,100). The up vector points in the z-direction as required. To make this slightly more complicated, assume you have an instance in your room that specifies the position of the camera. It will have a current (x,y) position and a direction (and maybe even a speed). You can now specify this as your camera by using the following code:

```
{
    with (obj_camera)
        d3d_set_projection(x,y,10,
                           x+cos(direction*pi/180),y-sin(direction*pi/180),10,
                           0,0,1);
}
```

This might look a bit complicated. We look from the camera position (x,y), 10 above the ground. To determine a point in the correct direction we need to do a little arithmetic. This point is indicated by the next three parameters. Finally we use the up vector as above.

One important remark! When *GameMaker* starts drawing a room it will set the view point back to the default position. So the first thing you must do when drawing the scene is set it to the projection you want. This must be done in a drawing event!

There is also an extended version of the function above:

d3d_set_projection_ext(xfrom,yfrom,zfrom,xto,yto,zto,xup,yup,zup,angle,aspect,znear,zfar)

An extended version of this function in which you also specify the angle defining the field of view, the aspect ratio between horizontal and vertical size of the view, and the near and far clipping planes.

The additional parameters work as follows. If you specified the camera position, point to look at, and up vector, you can still change how wide the lens of the camera is. This is called the field of view. A reasonable value is somewhere between 40 and 45 degrees. But you can change this if you like. Next you can specify the aspect ratio between the horizontal and vertical projection. Normally you want to use the same as the aspect ratio of the room or view, e.g. 640/480. Finally you can indicate the clipping planes. Objects that are closer than *znear* to the camera are not drawn. Similar for objects further than *zfar*. It can be important to set these parameters to reasonable values because they also influence the precision of the z-comparisons. If you make the range too large the precision gets worse. Default we use 1 and 32000. *znear* must be larger than 0!

Sometimes you temporarily need a normal orthographic projection as is used when there is no 3D. Or you want to return to the default perspective projection. For this you can use the following functions:

d3d_set_projection_ortho(x,y,w,h,angle) Sets a normal orthographic projection of the indicated area in the room, rotated over the indicated angle.

d3d_set_projection_perspective(x,y,w,h,angle) Sets a normal perspective projection of the indicated area in the room, rotated over the indicated angle.

A standard use for this is to draw an overlay to e.g. show the score or other aspects. To do so we set an orthographic projection. We also must temporarily switch off hidden surface removal cause we want the information to be drawn regardless of the current depth value. The following example shows how to create an overlay with the score.

```
{
    draw_set_color(c_black);
    d3d_set_projection_ortho(0,0,room_width,room_height,0);
    d3d_set_hidden(false);
    draw_text(10,10,'Score: ' + string(score));
    d3d_set_hidden(true);
}
```

Transformations

Transformation allow you to change the place where things are drawn in the world. For example, the function to draw blocks can only draw axis-parallel blocks. By first setting a rotation transformation you can create rotated blocks. Also sprites are always drawn parallel to the xy-plane. By setting a transformation you can change this. There are two types of functions: functions that set the transformation and functions that add transformations.

d3d_transform_set_identity() Sets the transformation to the identity (no transformation).

d3d_transform_set_translation(xt,yt,zt) Sets the transformation to a translation over the indicated vector.

d3d_transform_set_scaling(xs,ys,zs) Sets the transformation to a scaling with the indicated amounts.

d3d_transform_set_rotation_x(angle) Sets the transformation to a rotation around the x-axis with the indicated amount.

d3d_transform_set_rotation_y(angle) Sets the transformation to a rotation around the y-axis with the indicated amount.

d3d_transform_set_rotation_z(angle) Sets the transformation to a rotation around the z-axis with the indicated amount.

d3d_transform_set_rotation_axis(xa,ya,za,angle) Sets the transformation to a rotation around the axis indicated by the vector with the indicated amount.

d3d_transform_add_translation(xt,yt,zt) Adds a translation over the indicated vector.

d3d_transform_add_scaling(xs,ys,zs) Adds a scaling with the indicated amounts.

d3d_transform_add_rotation_x(angle) Adds a rotation around the x-axis with the indicated amount.

d3d_transform_add_rotation_y(angle) Adds a rotation around the y-axis with the indicated amount.

d3d_transform_add_rotation_z(angle) Adds a rotation around the z-axis with the indicated amount.

d3d_transform_add_rotation_axis(xa,ya,za,angle) Adds a rotation around the axis indicated by the vector with the indicated amount.

Realize that rotation and scaling are with respect to the origin of the world, not with respect to the object that is to be drawn. If the object is not at the origin it will also move to a different place, which is not what we want. So to e.g. rotate an object over its own x-axis, we must first translate it to the origin, next rotate it, and finally translate it back to its position. This is what the functions to add transformations are for.

The following examples might explain this better. Assume we have a sprite `spr` that we want to draw at position (100,100,10). We can use the following code to do this

```
{
    d3d_transform_set_translation(100,100,10);
    draw_sprite(spr,0,0,0);
    d3d_transform_set_identity();
}
```

Note that because we use a translation we should now draw the sprite at position (0,0). (This assumes the current instance has a depth of 0! If you are not sure, first set the depth.) If we would use this in our first person shooter we would not see the sprite. The reason is that it is still parallel to the xy-plane. We want to rotate it over 90 degrees along the x-axis (or y-axis). So we need to add a rotation. Remember the order: we must first rotate the sprite and then translate it. So we can use the following code.

```
{
    d3d_transform_set_identity();
    d3d_transform_add_rotation_x(90);
    d3d_transform_add_translation(100,100,10);
    draw_sprite(spr,0,0,0);
    d3d_transform_set_identity();
}
```

Sometimes you temporarily want to save the current transformation, for example to add an additional transformation and then restore the old one (this often happens when drawing hierarchical models). To this end you can push the current transformation on a stack and later pop it from the stack to make it the current transformation again. The following functions exist for this:

d3d_transform_stack_clear() Clears the stack of transformations.

d3d_transform_stack_empty() Returns whether the transformation stack is empty.

d3d_transform_stack_push() Pushes the current transformation on the stack. Returns whether there was room on the stack to push it there (if you forget popping transformation you at some moment will run out of room on the stack).

d3d_transform_stack_pop() Pops the top transformation from the stack and makes it the current one. Returns whether there was a transformation on the stack.

d3d_transform_stack_top() Makes the top transformation the current one, but does not remove it from the stack. Returns whether there was a transformation on the stack.

d3d_transform_stack_discard() Removes the top transformation from the stack but does not make it the current one. Returns whether there was a transformation on the stack.

Using transformation is a powerful mechanism. But be careful and always set the transformation back to the identity once you are done.

Fog

La nebbia può essere usata nei giochi 3D per rendere gli oggetti sfocati o che svaniscono a distanza. Queste informazioni aiutano a creare una atmosfera e rendono possibile non tracciare degli oggetti che sono molto lontani. Per abilitare o disabilitare la nebbia usate la seguente funzione:

`d3d_set_fog(enable,color,start,end)` Abilita o disabilita l'uso della nebbia. `color` indica il colore della nebbia. `start` indica la distanza alla quale deve partire la nebbia. `end` indica la distanza alla quale la nebbia è al massimo dell'intensità e non è più possibile vedere nulla.

Per capire meglio cosa succede, ci sono di fatto due tipi di nebbia, la nebbia ordinaria e quella basata sul vertice. Il primo tipo calcola i valori della nebbia basandosi sul pixel. La seconda calcola il valore della nebbia per ogni vertice e poi li interpola. Il primo tipo è migliore ma non sempre supportato. *GameMaker* prova ad usare la nebbia ordinaria quando supportata o altrimenti usa quella basata sui vertici (a meno che non sia supportata la nebbia). Si noti che certe schede grafiche indicano il loro supporto alla nebbia ordinaria (table based), ma offrono all'utente la possibilità di disabilitarla in modalità avanzata di settaggio di visualizzazione. In questo caso il risultato potrà essere uno schermo nero!

Lighting

Le scene raffigurate con le funzioni citate sopra sono piuttosto piatte dato che non c'è luce. Anche il colore se le facciate sono uguali, indipendentemente dal loro orientamento. Per creare delle scene più realistiche da guardare dovete abilitare l'illuminazione e sistemare le luci nei posti esatti. La creazione di scene correttamente illuminate non è semplice, ma l'effetto è davvero soddisfacente.

Per abilitare l'illuminazione potete usare la seguente funzione:

d3d_set_lighting(enable) Abilita o disabilita l'uso dell'illuminazione.

Quando usate l'illuminazione, viene determinato il colore per ogni vertice di un poligono. Poi, il colore dei pixels interni è basato sul colore di questi vertici. Ci sono due modi per realizzare ciò: Sia l'intero poligono prende lo stesso colore, o il colore è leggermente interpolato sopra il poligono. Viene usata predefinitivamente una sfumatura liscia. Ciò può essere modificato usando la seguente funzione:

d3d_set_shading(smooth) Imposta se usare o no la sfumatura liscia.

Per usare l'illuminazione ovviamente avete necessità di definire le luci. Esistono luci diverse: luci direzionali (come il sole), e luci posizionabili. La luce ha un colore. (Supportiamo solo luci diffuse, nessun riflesso speculare) Di solito sono disponibili solo 8 luci tramite hardware, quindi dovreste usare le funzioni qui sotto per modificare le luci "attive", non solo tutte le luci della scena. Esistono le seguenti funzioni per definire ed usare le luci:

d3d_light_define_direction(ind,dx,dy,dz,col) Definisce una luce direzionale. *ind* è l'indice della luce (usa un piccolo numero positivo). (dx,dy,dz) è la direzione della luce. *col* è il colore della luce (spesso si usa *c_white*). Questa funzione non attiva la luce.

d3d_light_define_point(ind,x,y,z,range,col) Definisce un punto luce. *ind* è l'indice della luce (usa un piccolo numero positivo). (x,y,z) è la posizione della luce. *range* indica quanto lontano brilla la luce. L'intensità della luce decresce lungo questo range. *col* è il colore della luce. Questa funzione non attiva la luce.

d3d_light_enable(ind,enable) Attiva (true) o disattiva (false) la luce *ind*.

La prossima funzione serve per controllare una particolare luce chiamata luce *ambientale*. La luce ambientale è una particolare luce che illumina dove non è presente della luce. E' effettivamente il colore della luminosità della scena. Per controllare questa luce usate questa funzione:

d3d_light_define_ambient(colour) Il colore di default è \$000000 (black)

Il modo con il quale un oggetto riflette la luce dipende dall'angolo tra la direzione della luce e dalla perpendicolarità della superficie, cioè, la rotta di puntamento lontana dalla facciata, questa rotta è chiamata "normale" (normal) di una superficie. Quindi, per creare oggetti illuminati avete bisogno non solo di fornire la posizione dei vertici ma anche le loro perpendicolarità. Sono disponibili per questa necessità quattro funzioni per definire i vertici delle primitive:

d3d_vertex_normal(x,y,z,nx,ny,nz) Aggiunge un vertice (x,y,z) alla primitiva, con un vettore perpendicolare (nx,ny,nz).

d3d_vertex_normal_color(x,y,z,nx,ny,nz,col,alpha) Aggiunge un vertice (x,y,z) alla primitiva, con un vettore perpendicolare (nx,ny,nz), e con il proprio colore e canale alpha.

d3d_vertex_normal_texture(x,y,z,nx,ny,nz,xtex,ytex) Aggiunge un vertice (x,y,z) alla primitiva, con il vettore perpendicolare (nx,ny,nz), e con la posizione (xtex,ytex) nella texture, mischiandolo prima con il colore e il canale alpha.

d3d_vertex_normal_texture_color(x,y,z,nx,ny,nz,xtex,ytex,col,alpha) Aggiunge un vertice (x,y,z) alla primitiva, con il vettore perpendicolare (nx,ny,nz), e con la posizione (xtex,ytex) nella texture, miscelandolo con il proprio colore e il canale alpha.

Si noti che per le forme base che potrete raffigurare il vettore di perpendicolarità è impostato correttamente in automatico.

Creating models

Quando hai bisogno di disegnare dei modelli grandi c'è abbastanza costoso chiamare tutte le differenti funzioni di disegno ad ogni step. Per evitare questo puoi creare dei modelli. Un modello consiste in un numero di disegni di primitive e di forme. Una volta creato il modello puoi disegnarlo in posizioni differenti con una sola funzione. I modelli possono anche essere caricati o salvati in un file.

Prima di descrivere le differenti funzioni disponibili c'è un importante punto: la manipolazione delle textures. Come descritto prima, le texture vengono prese da sprites e backgrounds. Gli indici delle texture possono essere differenti in differenti momenti. Quindi i modelli non contengono nessuna informazione sulle texture. Solo quando disegni un modello fornisci la texture. Quindi puoi usare solo una texture in un modello. Se hai bisogno di più textures devi unirle in una sola (trattando attentamente con le coordinate della texture) o usare più modelli. Il vantaggio è che puoi disegnare lo stesso modello con textures differenti.

Per creare, caricare, salvare, e disegnare modelli, esistono le seguenti funzioni:

d3d_model_create() Crea un nuovo modello e restituisce il suo indice. L'indice verrà usato in tutte le altre funzioni che trattano coi modelli.

d3d_model_destroy(ind) Distrugge il modello con l'indice indicato, liberando la sua memoria.

d3d_model_clear(ind) Ripulisce il modello con l'indice indicato, rimuovendo tutte le sue primitive.

d3d_model_save(ind, fname) Salva il modello nel file indicato.

d3d_model_load(ind, fname) Carica il modello dal file indicato.

d3d_model_draw(ind, x, y, z, texid) Disegna il modello alla posizione (x,y,z). *texid* è la texture che dev'essere usata. Usa -1 se non vuoi usare una texture. Se vuoi ruotare o ridimensionare il modello puoi usare le routines di trasformazione descritte prima.

Per ogni funzione che tratta le primitive ce n'è una equivalente per aggiungerle al modello. Le funzioni hanno gli stessi argomenti, ma hanno come primo argomento l'indice del modello, e non sono necessarie le informazioni sulla texture.

d3d_model_primitive_begin(ind, kind) Aggiunge una primitiva 3D del tipo indicato: *pr_pointlist*, *pr_linelist*, *pr_linestrip*, *pr_trianglelist*, *pr_trianglestrip* o *pr_trianglefan*.

d3d_model_vertex(ind, x, y, z) Aggiunge il vertice (x,y,z) al modello.

d3d_model_vertex_color(ind, x, y, z, col, alpha) Aggiunge il vertice (x,y,z) al modello, specificando il colore e la trasparenza.

d3d_model_vertex_texture(ind, x, y, z, xtex, ytex) Aggiunge il vertice (x,y,z) al modello, specificando le coordinate della texture.

d3d_model_vertex_texture_color(ind, x, y, z, xtex, ytex, col, alpha) Aggiunge il vertice (x,y,z) al modello, specificando texture e colore.

d3d_model_vertex_normal(ind, x, y, z, nx, ny, nz) Aggiunge il vertice (x,y,z) al modello, con un vettore normale (nx,ny,nz).

d3d_model_vertex_normal_color(ind, x, y, z, nx, ny, nz, col, alpha) Aggiunge il vertice (x,y,z) al modello, con un vettore normale (nx,ny,nz), and with its own color and alpha value.

d3d_model_vertex_normal_texture(ind, x, y, z, nx, ny, nz, xtex, ytex) Aggiunge il vertice (x,y,z) al modello, con un vettore normale (nx,ny,nz), e con la posizione della texture.

d3d_model_vertex_normal_texture_color(ind, x, y, z, nx, ny, nz, xtex, ytex, col, alpha) Aggiunge il vertice (x,y,z) al modello, con un vettore normale (nx,ny,nz), con la texture e con i colori.

d3d_model_primitive_end(ind) Termina la descrizione della primitiva nel modello.

Oltre alle primitive, puoi anche aggiungere delle forme di base al modello. Le funzioni sono quasi uguali ma con un indice del modello e senza le informazioni della texture:

d3d_model_block(ind, x1, y1, z1, x2, y2, z2, hrepeat, vrepeat) Aggiunge un blocco al modello.

d3d_model_cylinder(ind, x1, y1, z1, x2, y2, z2, hrepeat, vrepeat, closed, steps) Aggiunge un cilindro al modello.

d3d_model_cone(ind, x1, y1, z1, x2, y2, z2, hrepeat, vrepeat, closed, steps) Aggiunge un cono al modello.

`d3d_model_ellipsoid(ind,x1,y1,z1,x2,y2,z2,hrepeat,vrepeat,steps)` Aggiunge un ellissoide al modello.

`d3d_model_wall(ind,x1,y1,z1,x2,y2,z2,hrepeat,vrepeat)` Aggiunge un muro al modello.

`d3d_model_floor(ind,x1,y1,z1,x2,y2,z2,hrepeat,vrepeat)` Aggiunge un pavimento al modello.

Usare i modelli puÃ² velocizzare significativamente la grafica nel vostro gioco 3D e tu dovresti usarle ogni volta che puoi.

Ultime parole

Le funzioni 3D di *GameMaker* possono essere usate per creare degli ottimi giochi 3D. Comunque, sono limitate in funzionalità e lasciano ancora un bel po' di lavoro per voi. Non aspettarti di poter fare il tuo *Quake* con esse. *GameMaker* è e rimane principalmente un pacchetto per creare giochi 2D.

Progettare videogiochi con GameMaker

Versione 8.1
by
YoYo Games Ltd.

La documentazione di *GameMaker* Ã" divisa in quattro parti:

Usare GameMaker

Questa sezione descrive l'uso basilare di *GameMaker*. Espone l'idea generale che sta dietro al programma e descrive come aggiungere sprite, sfondi e suoni e come definire oggetti con eventi ed azioni e come aggiungerli nelle room.

In questa sezione sono presenti i seguenti argomenti:

- [Introduzione](#)
- [Installazione](#)
- [Aggiornare dalla Lite Edition](#)
- [Iniziare](#)
- [L'interfaccia globale dell'utente](#)
- [Definire gli Sprites](#)
- [Suoni e musica](#)
- [Sfondi](#)
- [Definire gli Objects](#)
- [Eventi](#)
- [Azioni](#)
- [Creare Rooms](#)
- [Distribuire il gioco](#)

Uso avanzato

Questa sezione descrive gli aspetti piÃ¹ avanzati di *GameMaker*. Si tratta di path, fonts, time lines, scripts, e tecniche per generare room "piastrellate" ed usare le visualizzazioni nelle room.

In questa sezione sono presenti i seguenti argomenti:

- [L'interfaccia utente avanzata](#)
- [Di piÃ¹ sugli Sprite](#)
- [Di piÃ¹ su suoni e la musica](#)
- [Di piÃ¹ sugli sfondi](#)
- [Di piÃ¹ sugli Objects](#)
- [Altre azioni](#)
- [Costanti](#)
- [Eventi Trigger](#)
- [Includere files](#)
- [Di piÃ¹ sulle Rooms](#)
- [Fonts](#)

[Paths](#)
[Time Lines](#)
[Scripts](#)
[Estensioni](#)
[Esportare e Importare Risorse](#)

Completare il tuo gioco

Questa sezione descrive come passare da un progetto ad un gioco finito. Descrive come aggiungere informazioni di aiuto nel tuo gioco, come impostare le varie opzioni per il tuo gioco e come creare giochi eseguibili che possono essere distribuiti agli altri ed essere avviati senza avere la necessità di usare *GameMaker*.

In questa sezione sono presenti i seguenti argomenti:

[Informazioni del gioco](#)
[Impostazioni globali del gioco](#)
[Considerazioni sulle prestazioni](#)

The GameMaker Language

GameMaker usa un linguaggio di programmazione proprietario. Questo linguaggio offre molta pi  flessibilit  e controllo delle normali azioni. Questo linguaggio   chiamato GML (*GameMaker* Language). In questa sezione descriviamo il linguaggio GML e diamo una panoramica su tutte le circa 1000 funzioni e variabili che possono essere usate per controllare tutti gli aspetti del tuo gioco.

In questa sezione sono presenti i seguenti argomenti:

[Panoramica del Linguaggio](#)
[Calcolare qualcosa](#)
[Game play](#)
[Interazione dell'utente](#)
[Grafica](#)
[Suoni e musica](#)
[Schermate iniziali, classifiche e altri pop-ups](#)
[Risorse](#)
[Modificare le risorse](#)
[Files, registro, esecuzione programmi e device specifico](#)
[Strutture dati](#)
[Creare particelle](#)
[Giochi multiplayer](#)
[Usare le DLL](#)
[Grafica 3D](#)

Novità di Game Maker 8.1

La versione 8.1 di *GameMaker* ha alcuni miglioramenti e correzioni di bug rispetto alla 8.0.

Cambiamenti

- Cambiate le priorità del tasto destro del mouse nell'editor di room. Appare il menu normalmente, ma premendo Ctrl si attiva la cancellazione
- Modalità ZOOM nelle room aggiunta
- La rotellina del mouse esegue lo ZOOM nell'editor di room
- Il tasto centrale del mouse fa una panoramica della room.
- La finestra delle impostazioni dei background trasparenti " " è stata spostata alla finestra principale.
- Transparent Background grid size now a global setting.
- Transparent Background grid added to room editor.
- Transparent Background grid can now have user colours.
- Image Editor now uses the mouse wheel to zoom.
- Image Editor now uses the middle mouse button to "pan"
- Can now PAN around inside the PATH editor using the middle mouse button.
- You can now change the default background colour for rooms (when no ROOM background has been set)
- You can now disable background room filling, so you can see the background GRID when no ROOM colour has been set.
- Added +/- zoom buttons to Room toolbar
- You can now RIGHT CLICK an object and EDIT it from within the Room Editor.
- Rendering inside the Code Editor sped up.
- inside the code editor, you can now mark a block of text and use TAB and SHIFT-TAB to tab it in and out.
- News window now resizable.
- Room settings now remembers "maximised" setting.
- Shiny new ABOUT box.
- Resource renaming changed back to windows default; F2 (was changed from F2 to CTRL-R in GM 8.0)
- Code window now has a "toggle" icon for Code Completion on/off
- You can now press ESCAPE inside the code editor to get rid of the code completion box.

- GameMaker now saves .gm81 files (instead of .gmk)
- New .EXE encryption
- New News feed system added
- draw_self() added
- os_type returns you the operating system your running on (win, mac, ios etc.)
- os_device returns you a device type (iPhone, iPhone4, iPad etc.)
- ZBuffer is now 24Bit
- Hardware T&L for Faster 2D and 3D rendering.
- You can now change the background colours of the code editor, including the current line and selection.
- "Delete underlying objects" Now off by default in the room editor.
- You can now use <AltGr> (right alt) in the code editor to insert accented characters.
- d3d_light_define_ambient(colour) added for a global ambient
- You can now set the default TAB on the object panel (so you can default to the code panel for example)
- In Standard Edition, script searching will now search ALL scripts, including objects, rooms, creation events, timelines and triggers.
- added dot_product(x1,y1, x2,y2)
- added dot_product_3d(x1,y1,z1, x2,y2,z2)
- added point_distance_3d(x1,y1,z1, x2,y2,z2)
- Font creation totally rewritten. Now produces much nicer anti-aliased fonts, and doesn't cut them off.
- You can now change the "Execute a piece of code" in D&D action list, by using the 1st line of your script and a "///" style comment at the start.

Fixes

- Undo in Text Editor. when you undo a change and then save the script or run the game, the change is not saved.
- Error in reading reals from text files. When you read two numbers from a single line in a text file and the first one is 0, the numbers are not read correctly.
- 0000536. mp_grid_add_cell is bugged. Also fixed same issue in mp_grid_clear_cell is bugged
- 0000597. Overly large images were not being clamped correctly and were causing corruption.
- 0000589: tile_layer_find() doesn't account for scaling. (also in tile_layer_delete_at(), tile_find(), tile_delete_at())
- 0000255: Replacing code at the start of the line. cursor column was going negative.

- 0000580 - If you use `sprite_create_from_surface` on a blank surface the sprite will be completely opaque.
- `sprite_create_from_surface`: if you set parameter "removeback" to 2, it will now copy the alpha "as is".
- If you created a background image but didn't add one, the game would fail to load.

What is New in Version 8.0

Version 8.0 of *GameMaker* has a large number of improvements over version 7.0. Below the most important changes are described.

Incompatibilities

Text splash screens can no longer show images. However, web splash screens have been added that can show full html documents with images, etc.

A number of changes have been made to the functions related to sprite and background resources. This is due to the fact that *GameMaker* uses a completely new mechanism for these resources. If your game uses a lot of calls to functions that load or save image resources on the fly you are strongly recommended to keep using the old version 7.0 for that game.

If you use extension packages you will have to reinstall them.

Some changes have been made to the timeline mechanism that can lead to incompatibilities. In particular, assigning a timeline and starting it are now two separate things.

An important bug has been solved in which collision events were executed twice if two objects have collision events with each other. Some games however might have relied on this bug and, hence, might no longer function correctly.

News

GameMaker now default shows a News page when it is started. Here new versions will be announced, new resources will be indicated, there is information about competition, and game design tips and tricks. News is shown only once a day. In the Standard Edition this can be switched off. You can always access the news through the Help menu and you are encouraged to regularly check the news for important information about *GameMaker*.

Tutorial

GameMaker now has a standard built-in tutorial for beginners. It is shown in a panel at the right of the screen. Experienced users can indicate that they do not want to see the tutorial anymore. To accommodate for the tutorial panel, *GameMaker* is now default started in full screen mode. It does however remember its settings so changing it once to windowed mode will from that moment on start it in that mode.

Alpha-blended backgrounds and sprites

The new version *GameMaker* uses backgrounds and sprites with alpha (transparency) channels. This makes it possible to create and use much nicer sprites. PNG files with such information are now correctly loaded. The sprite and image editor have been completely rewritten, including many new drawing options and effects. A new sprite file selector was added that shows the animations in the sprites. Also we bundle a large number of high-quality sprites with *GameMaker* that you can use for free in your games.

Enhanced collision checking

You now have more collision checking options. For example, you can indicate that collisions should be with an enclosed disk and you have better control over the bounding box. The sub-image of the sprite can have a combined mask and you can set the dependence on the alpha transparency value.

Splash screens

A new function `splash_show_web(url,delay)` has been added that can be used to show web pages as splash screens. You can also use local html pages for this. This allows for a powerful mechanism to e.g. create help pages. A close button is added to the splash screens. Also a number of new actions have been added to show the different types of splash pages and to change splash settings. (The old Show Video and Webpage actions have been removed as the new actions include them. They will though still work in old games.)

Trigger events

A new type of event has been introduced: Trigger events. Trigger events you can specify yourself. You give them a name and a condition, written in GML. After this they can be used in all objects, just like other events. With this you can easily extend the functionality of *GameMaker*.

Time lines

The timelines have been extended. The property form has additional buttons to e.g. spread out the moments and to delete or duplicate ranges of moments. Timelines can now be paused and restarted and they can even be played backwards. Also they can now loop automatically.

Importing and exporting resources

The possibility to merge games has been replaced by a much more extensive system to import and export resources. The user can indicate which resources to export to a file (.gmres). Next they can be imported in a different game. In principle only one resource can exist for each name. When there is a name conflict when importing the user can specify to keep the original, replace anyway, take the one that is most recently changed, or keep both (not recommended). To be able to do the third option, all resources now keep track of when they were last changed.

Rewritten script and code editor

The built-in script/code editor has been completely rewritten, making it a lot easier to write code. For example there is pop-up function name completion, argument help, matching brackets, improved color coding, line numbers, on-the-fly error checking, code snippets, and a sophisticated find and replace functionality.

Speed improvements

The speed of games that use code has been considerably improved. A speed-up of up to 100% is sometimes possible. Also the loading time for games is often considerably improved. Also when running a stand-alone game.

Other changes

There are a number of other changes and additions. Here are some of the important ones.

- You can now use high quality icons for your games.

- Constants can now be defined in their own form (rather than through the Global Game Settings). As a result they can remain visible while you are e.g. writing scripts. You can also load and save the constants to text files.
- Also included files are no longer shown in the Global Game Settings but in their own form.
- Many small visual improvements
- Added function `random_range(x1,x2)`, `irandom(x)`, and `irandom_range(x1,x2)`. The latter do give integer results and can include `x` or `x2`.
- Added functions `mouse_wheel_up` and `mouse_wheel_down`.
- Added a function `set_application_title(title)` to set the title of the application (which is shown in the taskbar).
- Added function `file_text_eoln()`.
- Added read-only variable `debug_mode`.
- There is now a game setting to disallow screensavers or powersaving options (sleep, hibernate) while the game is running (default disallowed).
- Added functions `disk_size(drive)` and `disk_free(drive)` and a variable `gamemaker_version`.
- Runtime error messages better indicate the position of the error
- You can now change to location of the temporary files, see the page on Preferences.

Corrected bugs

The following bugs were corrected. A number of other smaller bugs were corrected as well.

- An error message when starting the Maker on Vista with Active User Control is now removed.
- Corrected a bug that when using Alt many fields in forms became invisible under Vista.
- Corrected a bug with action hints not showing in the object and time line forms.
- When opening a game or starting a new one, no longer for all open changed resource windows a separate save confirmation question is asked.
- Corrected a (sort of) error with the precision of comparison operators in code.
- Solved bug with a bad background for the Applies To field in code editor.
- Creating a standalone now correctly checks whether there are any rooms.
- Replaced all Ctrl+Alt combinations by Shift+Ctrl because some of combinations are important for German keyboards. Also corrected the shortcut for creating sprites.
- In simple modes, short-cuts for hidden resources and menu items now are disabled as well. Also the Scripts menu is hidden.
- Corrected a bug in the function `window_get_color()`.
- Increased the limit on the number of vertices in drawing 3D primitives for models from 1000 to 32000.
- Corrected a bug in ignoring z-value for model vertices.
- Corrected the Outside View and Boundary View events.
- Game will now run (with warning) when there is no enabled sound card.
- When the game window loses focus, io events like key presses are now cleared.
- Corrected and improved error reporting for the creation code of rooms and instances in rooms.
- `room_tile_add` and `room_tile_add_ext` now correctly set the blending color to white and return the correct tile index.
- Now correctly setting the application title to the file name.
- Corrected a bug in `draw_line_width_color` when the length is 0.
- Tiles with negative scale factors are now correctly drawn.
- Changed the reading and writing of reals in text files. As decimal separator now always a dot is used. However, when reading, both a dot or comma are accepted.
- A group of resources that is empty will now have the correct closed folder icon.
- Solved the problem with the flashing of the resource tree.
- Functions `string` and `string_format` no longer crash when the number is too large and they will return the string ERROR.
- Long paths are now correctly drawn with `draw_path`.
- Collapsing the resource tree now works correctly.
- In an if condition, a value of 0.5 is now treated as true.
- Solved a bug that sometimes occurred when pressing the ~ key.
- `sign()` function now correctly returns 0 when the argument is 0.
- In the path editor, when choosing a room, clicking outside the menu no longer clears the room.
- Slightly enlarged the debug form to show all toolbar icons. Also made the watch grid columns scale when the form

resizes.

- Corrected a bug that can cause a crash when resizing the game window to 0 height.
- Solved a bug in `ds_grid_add/multiply/set_grid_region`.
- Calls to scripts and extension functions now return a value of 0 when they do not assign a return value themselves.
- Solved a serious bug in which collision events were executed twice if two objects have collision events with each other.
- Solved a bug in `draw_text_ext` with empty lines (multiple #) and a problem with drawing strings that contains CR-LF pairs (when using multiline strings in code).
- Read-only files can now be used as included files without errors.